Effect of Sessional Variation of Running On Body Fat, Endurance and Performance of Athletes

A Thesis
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Doctor of Philosophy in Physical Education 2006

By

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Declaration of the Supervisor

CERTIFICATE

This is to certify that the work entitled **"Effect of Sessional Variation of Running on Body Fat, Endurance and Performance of Athletes"**, is a piece of research work done by Mrs. Vijaya Y. Rangari under guidance and supervision for the degree of Doctor of Philosophy in Physical Education, M.D.I.P.E.S.,, Bundelkhand University, Jhansi (U.P.), India. That the candidate has put in an attendance of more than 200 days with me.

To the best of my knowledge and belief the thesis:

1. Embodies the work of the candidate himself.
2. Fulfils the requirement of the ordiance relating to Ph.D. Degree of the University; and
3. is upto the standard both in respect of contents and language for being referred to the examiner.

30/11/06

(Dr. A.K. SRIVASTVA)
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Declaration by the Candidate

I declare that the thesis entitled, **"Effect of Sessional Variation of Running on Body Fat, Endurance and Performance of Athletes"**, is my own work conducted under the supervision of Dr. A.K. Srivastva, Director, Physical Education, Delhi College of Engineering, Delhi-110042, approved by R.D.C. I have put in more than 200 days of attendance with the supervision.

I further declare that to the best of my knowledge that the thesis does not contain any part of my work, which has been submitted for the award of any degree either in this University or in any other University without proper citation.

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CHAPTER - 1

INTRODUCTION

EFFECT OF SESSIONAL VARIATION OF RUNNING ON BODY FAT, ENDURANCE AND PERFORMANCE OF ATHLETES

CHAPTER I

INTRODUCTION

Session is considered as specific period of the year cherecterised by distinctive temperature, rainfall, vegetation and the life, which occur at different times in different regions and is determined by the position of the earth in relation to the sun.[1]

Climate and weather come under the preview of season. Weather is the state of the atmosphere at any particular time with respect to conditions of temperature, pressure, humidity or other meteorological phenomena.[2] The long term manifestations of the weather are called the climate.[3] the climate of any region is represented by the statistical properties of the weather over an extended period[4].

Of the many factors that influence human performance related to sports and exercise, season may be one of them.

Modern researches conducted to find out level of performance in individual sports and team-games during various seasons have indicated

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[1]New Webster's Dictionary of the English Language (College Edition) Fourth Indian Reprint, (Delhi, Surjeet Publications, 1983) P.1356.

[2]Ibid P. 1759.

[3]Felix Gad Sulman, "Health, Weather and Climate." (Munchen : S. Karger Basel, 1976) p. 8.

[4]Ibid P. 8

influence of seasons on the performance level, so also on the growth pattern.

Rose Marry Rummel[1] (1975) stated that a study of effect of climatic condition and biorhythm on performance level induces one to think whether or not there is fluctuation in one's own performance level during different seasons of the year or the same level of performance is maintained by the athletes if other conditions remain same being controlled properly.

W.T. Porter[2] (1920) shows the evidence of seasonal fluctuation in heights of school children. His data of eight years show, a maximal gain in the fall and early winter, and a period of minimal gain in the late spring and early summer.

In a study to find out influence of seasons on rate of growth of children L.S. Holt and H. Fales[3] (1925) observed that the rate of increase in growth from June to December exceeded that of December to June. There was the tendency toward a more rapid gain in the return months.

Blayer's[4] (1917) observations reveal that period from mid-summer to late fall as the period of acceleration of growth, winter a period of retardation, and spring and early summer a period of greater retardation.

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[1]Rummel Rose Mary : "Individual and Team Bio-Rhythms and Performances in the 1975 AIAN National Basketball Championships". In NAGIS Research Reports Volume III. Bd. by M. Adrian and J. Bramo. (Washington : AAHPER, 1977). p. 24.

[2]T.W. Porter, "Seasonal Variation in Growth of Children," American Journal of Physiology, III (May, 1920), 121-131. cited in R.Q. 4 : 1, March, 1933, p. 189.

[3]L.E. Holt and H. Fales, "Health and Growth of Children," American Journal of Diseases of Children, XXVI, (July, 1933), p. 1 and on cited in R.Q. 4 : 1, March, 1933, p. 180.

[4]A. Blayer, "Periodic Variation in the Rate of Growth of Infants," Archives of Pediatrics, XXXIV (May, 1917) p. 367 and on. Cited in R.Q. 4 : 1, March, 1933, p. 192.

In comparing the seasonal growth of the children it is observed by Cheny[1] (1923) that the gain for each child during the winter period was greater in every case that was the gain in the spring.

In order to know that changes in physiological parameters during different seasons of the year university Football players were tested by Hammer[2] in May, August, October, November and December. It was observed that the diastolic blood pressure response to a cold processor test (right hand immersed in ice water at 4°C) dropped significantly from May to October, and was significantly lower in October and December than in August. Pulse rates during recovery from a step test were lower in August, October and November than in May, but the December rates were significantly higher than in August. Standing broad jumps were longest in May and December and shortest in November. Agility run performances improved significantly only from May to August. Coaches ranking of players correlated significantly only with the broad jump and step test scores.

Varsity Football players participated in a spring conditioning programme consisting of exercises, weight training, wrestling, endurances, running, and speed and agility drills. Eight tests of the strength and power of arms and legs were administered at the beginning and of the conditioning programme and at the beginning and of the Football season in successing fall. A treatment by subject analysis of variance revealed significant increases in most tests during the conditioning period with subsequent

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[1]H. Chaney, "A comparison of the value of Milk and Oranges as supplementary Lunch for Underweight Children", American Journal of Diseases of Children, XXVI (October, 1923), p. 337 and on. Cited in R.Q. 4 : 1, March, 1933, p. 192.

[2]M. Hammer, "Physiological changes during period of Football Training and do-Training". Ed. D. in physical education, 1963, in Completed Research in HPER 8 : 1966. p. 77.

decrease during the summer months. The performance at the end of the summer months was good on all tests as it the beginning of the conditioning period and was significantly better in three instances. Significant improvements were obtained during the Football Season only in speed of the legs and power of the arms[1].

It is further observed that the sites of the earlier Olympic Games have been by and large located above 35° of Latitude. The XIXth Olympic Games were, as an exception, held in the city of Mexico in the year 1968. Although this city falls in the tropic belt, it is however, 7,350 feet above sea level. It was for the first time that the games were held at such a high altitude, and because of this advantage, the tropical heat was not felt. The subsequent games were held at Munich (1972), Mentreal (1976) and Moscow (1980). So also, the current year (1984) games are scheduled at Los Angles (U.S.A.) and the 1988 Olympic Games will be held at Soul (South Korea). All these cities are located above the tropical halt. (Ref. World Map).

It is evident, therefore, that the usual month of holding the Games would necessarily be July-August or September-October.

It is a fact to note here that the athletes of the countries of tropical belt are exposed to severe heat of the tropic during the pre-competition period, which is considered most critical and burdensome one in which optimum amount of training load is borne by the athletes. In view of the scheduled dates of Olympic Games in July-August, the

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[1]Carl Calvin Richardson. An Evaluation of an off-season conditioning programme for college football players. (Unpublished Doctoral Dissertation, Uni. of Teases 1965) p. 131. Cited in Completed Research in HPER (Vol. 8 : 1966). 106.

pre-competition period is pushed back to earlier four months i.e. from March to June, which is the peak of summer season in tropical countries.

AYURVEDIC THEORY OF SEASON AND BODILY STRENGTH

Ayurved is the science of medicine and health developed in India centuries age. Revealing information is found in the text of Ayurveda about health, strength, fitness, body types, exercises, diet and season.

The former representing the hotter season of the year and the latter the cooler season. Each of these periods is further divided into three smaller periods called "Rutus".

Thus, the Adane Kal consists of three "Rutus" namely shishir, Vasant and Grishma, whereas the Varsha, Shared and Hement "Rutus" for the Visarga Kel, as shown in figure 1.1.

Ayurveda also discusses exercise and body strength in relation to season. It is stated in Ayurvedic Texts[1] that the natural strength of the body, called "Bala", is greatly influenced by the seasons. It shows fluctuations according to seasonal cycles. Thus, the "Bala" is stated to be dissipated and at its lowest ebb in the Adana Kal i.e. hotter season. On the other hand "Bala" is stated to be conserved and at its highest optimum level in the Visarga Kal corresponding to Varisha, Sharad and Hemant Rutus which represent the cooler season of the year. It is suggested that the flucturation in bodily strength as per change in season should be taken into consideration and correct estimation of one's own strength should be made before resorting to exercise. This reflects that one should resort to exercise when the "Bala" or natural strength of the body is at its highest optimum level, i.e. in the Viserga Kel or the cooler

season, the Varsha, shared and Hemant respectively. It has been stated in these texts, that the intensity of exercise be reduced and a period of no-exercise be observed during Adana Kal i.e. hotter season of the shishir, Vasant and Grishma.

STATEMENT OF THE PROBLEM

As stated earlier, the scheduled dates of Olympic games usually fall in the months of July and August. The pre-competition period for the athletes of the tropical countries is counted from February to June. The period between these months is the summer season where the maximum temperature of the year is witnessed and in the same period the optimum amount of training load is borne by the athletes. The period in which bodily exercise is to be ceased as per Ayurvedic principles, becomes most burdensome, critical and important period for the sportsmen of tropical counties like India and other neighboring countries. When the natural vitality or bodily strength is at its lowest ebb during the summer and the autumn, it is only in this period that the Indian athletes are expected to put up their best. This may by one of the significant causes of low-level of performance of Indian athletes during the Olympic Games.

On the other hand when the international sports meets are organised during winter i.e. December, January, when the natural strength of the body is at its optimum level, and the load of exercise has also gone up, the performance level would be better. During the previous Asian Games at Bangkok in the month of December, 1973 and IX Asian Games at New Delhi in November 1982, at both the times the Indian athletes have given comparatively better performance than the Olympic Games of 1976 held at Montreal and in 1980 at Moscow Olympics.

The problem is, therefore, undertaken for investigation to find out "Effect of seasonal variations of Running on the body fat, Endurance and performance athletes."

HYPOTHESIS

It is hypotesised that the performance level of the athletes is considerably influenced by the variation in seasons.

PURPOSES OF STUDY

1. To find out effect of hot season on the performance level.
2. To find out effect of cold season of the performance level.
3. To find out the effect of seasonal fluctuation on performance level.
4. To verify the theoretical knowledge of Ayurveda about exercise and season.

SIGNIFICANCE AND JUSTIFICATION OF THE PROBLEM

The present study carries significance due to involvement of following issues :

1. There is an increasing awareness of curiosity to know more and more about the past of India. Indian civilisation is one of the oldest civilisations of the world. Many branches of knowledge were developed in India thousands of years ago. Sciences like engineering, architecture, medicine, chemistry, mathematics, astrology, etc. had progressed to a great extent. Well established universities were functioning in India which were disseminating knowledge all over world.

Present study is an humble attempt to test the ancient knowledge of exercise with modern scientific methods and to know its value in present period.

2. The study also reveals information about the influence of seasonal variation in performance level of the sportsman. Positive indications are obtained about such an influence, and the time has come for the sports coaches and trainers in India to think in the light of the observations of the proposed study, about planning of the training schedule according to the seasons of the year.

3. Similarly, they will also have to think over the issue of participation in international so also, national level competitions which are held during hotter season or soon after it.

4. The present study may also further motivate the future researchers to undertake study of knowing physiological ill-effects, if any, due to strenuous practice of physical exercise during the hot season, and the loss this athletes of tropical countries have to incur in respect of their physical performance when they are forced to put up their best during unfavourable season of the year every time during Olympic games.

5. Work has been done by earlier research workers to investigate the effects of extreme heat and cold on the performance level, similarly, efforts were also made to know the influence of particular season on the growth pattern. However, the study of athletes of tropical countries in respect of their performance at national and international level during summer or soon after summer, was not undertaken earlier. Therefore, the present attempt is a pioneer one.

In view of the issues raised as above, the investigation of the present study is significant and justifiable.

DESIGN OF THE STUDY AND METHODOLOGY

The study has been conducted in three different parts as shown below :

1. Experimental study
2. Questionnaire study
3. Study of past performances of the Indian Athletes.

A brief outline of each part is described below :

EXPERIMENTAL STUDY

The main object of the study was to investigate the effect of seasonal variation on the performance level of the athletes.

Since the national level athletes are scattered all over the country, it was not possible to make scientific observations of their performances in different seasons. In view of this difficulty, an alternative measure was considered to keep the high school students under observation for the year round and by recording their periodical performances in selected athletic events and Motor Ability Factors. Periods of their testing were placed to considered with the seasons. Following table (No. 12) shows the groups, number of students in them and the seasons and dates of testing.

Performance of each group in the following events and Motor Ability Factors was recorded:

1. 100 Mtrs.
2. Putting the shot
3. Running High Jump
4. Running Broad Jump
5. Zig Zag Run
6. Six Pound Medicine Ball Put
7. Standing Broad Jump.

It is evident from the Group A was tested for 9 times and remaining groups for 5 times in 7 events each time. Thus, including all the groups, 99 students had undergone various tests golf athletic performance and data of 3941 cases of athletics performance were collected and used for rigors statistical treatment. During the period of experiment of 15 months metobiological data were also collected to study the seasonal variations in weather conditions. These data included air temperatures, relative humidity and barometric pressure. The microbiological data were compared and correlated with the athletic performance.

The entire procedure of Experimentation that was followed and the results and conclusions along with inferences are presented in detail in Chapter 3.

QUESTIONNAIRE STUDY

The second part "Questionnaire Study" was undertaken with the purpose of obtaining conscientious of opinion of national level coaches and athletes about the effect of seasonal variation on performance level.

A special questionnaire was prepared in consultation with the experts in athletics and statistics, which was supplied in person and by post to the athletes and coaches preparing for 9th Asian Games and also to those who has long standing experience of athletic coaching or to the vetern athletes.

The information thus collected through the questionnaires was sorted out, analysed and interpreted.

The entire procedure that was followed in this part and the infrences derived therefrom are presented at length in Chapther 4.

STUDY OF PAST RECORDS AND PERFORMANCES

The purpose of this part of the study was to evaluate the sports career of some selected Indian athletes who has recorded their performances at national and international meets. A case study approach was made to deal with individual athletes and their performances. All the performances in each case were sorted out into the two major seasons viz. summer and winter of the year. By calculating mean and standard deviation of all the performances, a graph was plotted to distribute various performances according to their location at the graph. Thus, the performances of all the cases were analysed to find out status of performance in respect of the two seasons.

A total picture of all the cases was drawn up tabular form, which is presented in chapter 4.

Limitation of each part of study, the proposed hypotheses and the complete procedure that was followed to derive conclusions and inferences, are presented in respective parts of the study.

CHAPTER - 2

REVIEW OF LITERATURE

CHAPTER II
REVIEW OF LITERATURE

Scientific Literature in the field of medicine, Psychology, physical education, sports medicine and such other allied sciences deals with several topics concerned with the high performances in sports and the factors that influence the performance. Considerable research has been done and is still going on in the pursuit to know more and more about the secret of high performances.

Considerable work has been done in the field of considerable work has been done in the field of meteorology. The sports scientists have also tried to know the impact of weather conditions and the climate of the region on athletic performance. No doubt, weather affects individual personality and that there exists wide variation in climatic and weather conditions, however, it is difficult to know the type of climate that can be called as an ideal and suited most favourably to the individuals. It is interesting, in this context, to know the views expressed by Sulman[1] on the weather and climate that can be called ideal.

IDEAL WEATHER

It is refereed to as short term variations of the state of the atmosphere. This would include consideration of such things as air temperature, electricity, cloudiness, precipitation, and winds as they change from one month to the next or even from minute to minute[2]. The

[1]Felix Ged Sulmen, Health, Weather and Climate. (Munchen : S. Marger-sasel, 1976), 7.

[2]Ibid P. 8.

abnormal changes of weather keep us alert and the seasonal variations are undeniably bound to rejuvenate almost every person. There are places on earth where weather changes do not prevail, yet it is doubtful whether this contributes to our well being. Ideal weather is defined as suitable to one's constitutions[1].

THE IDEAL CLIMATE

The long term manifestations of the weather are called the climate. The climate of any region is represented by the statistical properties of the weather over an extended period[2].

While initiating discussion on various aspects of climate, the term microclimate is used to describe conditions over large areas, perhaps covering a state, country, or even a continent. When the entire planet is considered as a whole, it is stated to be the planetary or global climate[3].

The term microclimate is also used to specify the climate structure of the atmosphere between the Earth's surface and a height where the Earth's influence becomes indistinguishable. Such a layer measured in terms of meters, is of great importance in our health problems[4]. With reference to the factors that influence the temperature, Sulman talks of latitude and the altitude of the place with its location with respect to large water and land masses. The greater the elevation and the more pole ward the station, the lower the average temperature is likely to

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[1]Ibid

[2]Ibid

[3]Ibid, p. 9.

[4]Ibid.

be. Places over large land masses are said to experience continental climates, and they typically exhibit relatively large temperature changes from summer to winter, characterised by a pleasant moderate humidity. Since the temperatures of ocean and large latices change much less than do the temperatures of the continents, places just down wind from such bodies of water are not likely to experience the extremes of hot and cold as are locations for downwind. Such places enjoy a maritime climate[1]. strong, persistent ascending air motions, particularly if the air is warm and humid, and also around the equator. Such conditions are therefore, commonly found along the intertropical convergence none. Mountain ranges force air upward as well as acting as sources for convective clouds when their slopes are warm. As a result, precipitations ever mountains areas generally are higher than over flat lands when the air moving up the mountain slopes is both humid and unstable, spectacular amounts of rain can fall. In continuation of the discussion on the aspects of the climate, Sulman[2] talks about moderate climate and its specialities.

The two most important and obvious environmental factors according to T. Gilat et al.[3] are high altitude and high ambient temperature. Acclimatisation to high environmental temperature and humidity is of great importance to athletes. In addition to improving performance, such adaptations, are necessary to protect the athletes' health. Inadequate acclimetization may lead to serve physiological disturbances in the body,

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[1]Ibid

[2]Ibid, p. 14.

[3]T. Gilat, et al. "The Mechanisms of Heat Stroke". Journal of Tropical Medicine and Hygiene 66 : 204 (1963) cited in Encyclopedia of sports sciences and medicine. (New York : Macmfllan Company, 1971), 1370.

if there is vigorous exertion at relatively low air temperatures and high humidities, when net heat stress may be seriously understimated[1]. Even acclimatized subjects are susceptible if strenuous activities are performed with occlusive clothing[2].

Acclimatization to heat is accomplished by exertion in intense heat over a period of days. Complete acclimatization under test conditions results after a period of from 10–16 days[3]. Within 10 days approximately 80 to 90% of the ultimately attainable acclimatization will have occurred[4].

Regarding effect of acclimatization on the efficiency, Sulman[5] points out that men normally exercising in warm or hot environments may well be expected to perform better in competitions at high ambient temperatures than others usually exercising at comfortable or cool temperatures. Individuals from climates cooler than that in which exercise is to be performed may improve their competitive potentials by thermal pre-conditioning.

Sulman[6] mentions the following parameters that are involved in the improvement of acclimatization :

1. Increased blood volume ready to cope with any provocation by heat stress.

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[1]Ibid

[2]Ibid.

[3]John Sterner, "Acclimatisation.", Track Technique 25 : (September 1966), 775.

[4]Robinson, S.K. et al. "Effects of Desoxycorticosterone Acetate on Acclimatization of Man to Heat". Journal of Applied Physiology 2 : 399 (1950). Cited in Encyclopedia of sports science and medicine. The American College of sports medicine, (The macmillian company, New York). 1582.

[5]F.G. Sulman, op. cit. p. 71.

[6]Ibid.

2. Increasing the two hormones which can prevent salt loss by excessive seating i.e. Aldosterone of the adrenal order which retains sodium and anti diuretic hormone of the posterior pituitary gland which restricts urine output.

Referring the work of Hana 11. Seley on Heat Stress, Sulman[1] quotes there stages of an adaptation syndrome that are evoked due to Heat stress as described by selye :

Stage 1 : Alarm reaction (acute) involving hypothalamus, pituitary, adrenal medulla and adrenal cortex.

Stage 2 : Resistance (sub-chronic) involving the same organs, a reaction experienced by young people, especially males, and involving increased action of the above glands to cope with the challenge of the stress.

Stage 3 : Exhaustion (chronic) involving the above organs, a reaction experienced in particular by female as well as old people or old timers living for extensive periods in hot climates.

Regarding the ability to perform in hot environment Banister and Brown[2] state that the men who have become adapted to a hot environment or who are physically fit, or both, can perform the same amount of work as unacclimatized or less fit man at lower pulse rates and lower core temperatures. They can also tolerate higher environmental temperatures and can work at higher intensities at a given temperature then unacclimatized or less fit men.

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[1]Ibid. p. 73.

[2]B.W. Sanister and S.R. Brown "The Relative Energy Requirements of Physical Activity". Cited in Exercise Physiology Ed. Narold B. Falls. (New York : Academic press, 1968). 315.

Regarding ability to work in heat, Sulman[1] states that heat acclimatized individual demonstrate an increased ability to work in the heat without increasing body temperature. The respond to an acute heat stress with a more rapidly elicited sweat reflex and the production of a more dilute sweat. Acclimatization results in reducing the pulse rate and the cardiac output in trained man.

An acclimatized athlete perspires more, maintains a lower body temperature and lower heart state and is less inclined to orthostatic phenomena than a non-acclimatized athlete[2].

Inactivity in the heat produces little acclimatization. Subjects in good physical conditions acclimatize more rapidly and are capable of more work in the heat, than are those who are in poor condition. Repeated exposures to a hot climate lead to a progressive acclimatization to the adverse environment. The course of acclimatisation is speeded of fluid and salt balance are carefully monitored over this period[3]. The body acclimates itself to hot weather competition but only if training is carried out in the hottest part of the day. One cannot acclimate himself to running in hot weather by training early in the morning or in the cool of the evening when the actual race is to be run at mid-day[4]. If peak performance is expected for a particular sports events, practice should be held for several days prior to the event in the climatic conditions expected[5].

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[1] F.G. Sulman, op. cit. p. 70-70.

[2] G. Keren, shonfeld, E. Sohar, "Prevention of Damage by sport Activity in Hot climate: in JSMPF. 20 : 4.

[3] J.G.P. Williams & Sperryn : "Sports Medicine". (Edward Renold, Pub. Ltd. London 1976). p. 81.

[4] John Sterner, "Distance Running in Hot Weather", An Article in T.T. 6 : Dec. 1961 p. 170.

[5] Christine L. Wells "Problem of Temperature Regulation in Athletics". An article in D.G.W.S. Research Reports: women in sports. (Vol. II) (AAPHER N.W. Washington, 1973) p. 84.

Acclimatisation to heat is well retained during periods of no exposure upto approximately two weeks, after this period it is lost at varying rates depending on individual differences, most important of which is the physical condition of the individual. Most people lose a major portion of acclimatisation if they do not work out in the heat for two months[1].

Most of the benefits of acclimatization are lost during this period.

Acclimatisation plays an important part in the prevention of heat stroke and heat exhaustion. Rising concern is being evidenced over the increase in cases of heat exhaustion and heat stroke in sports. Among football players and distance runners there have been a number of deaths in high school and college, all of which were directly attributable to heat stroke[2].

Hot Climates are classified as hot dry or warm humid. Hot dry are usually in deserts and warm humid are in the tropical rain forest areas within latitudes 10-20° from the equator[3].

Abdel Halim[4] in his study on fluid and electrolyte balance and physical training in hot climate, clearly states that the teams from temperate

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[1]David E. Bass. "Protective Methods". An Article in Encl. of sports science and medicine : (New York Macmillen co. 1971.) p. 1582.

[2]C.S. Blyth and D.C. Arnold : 47th Annual survey of football fatalities, 1931-1978. Cited by C.E. klafs and D.D. Arnhein. Modern principles of Athletic Training. (London : C.V. Mosby Co. 1981.) p. 534.

[3]Abdel Halim. "Fluid and Flectrolyte Balance and Physical Training in Hot Climate." Olympic Review. 146. (Dec. 1979) p. 690.

[4]Abdal Halim. "Fluid and Electrolyte Balance and Physical Training in Hot Climate." Olympic Review No. 146. (December 1979), 693.

climates visiting tropical countries are at a disadvantage. For competitive sports in the tropics such teams should have training in hot weather to develop some degree of acclimatization. He recommends light clothing to protect against solar radiation and not to interfere with evaporation of sweat. Regarding fluid intake, hydration prior to sports events is recommended as long as it is in small repeated volumes. He further suggests construction of stadia lighted for evening events in countries with adverse climatic conditions.

A population study[1] was conducted on the participating athletes of 1952 Olympic Games, with the object to examine the question whether athletic performance are modified by temperature. Findings of the study are most revealing. The procedure of study seemed to be different than the design of case study. The standard map of annual isotherm and climatic zones of the world was used as basis of evaluation. Each country was classified into temperature zones in accordance with the climato-geographic position of the region in which the majority of its population reside.

Klausen et al.[2] report a decrease of about 10% in maximum Vo_2 in the desert as compared to moderate climatic conditions. At sub-maximal work loads the oxygen uptake was found to be lower, rendering the muscles more anoxic in the heat, where a greater part of the cardiac output was distributed to the skin for thermoregulatory reasons. As a

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[1]E. Jokl Performance and Environment. Documents Geigy (Bombay : M.N. Karnai for Sahrid Geigy Trading Ltd. 1967) 3-4.

[2]Klausen et al. "Metabolic Reactions to work in the Desert." Jour. Of Applied Physiology. 22 : 1967. Cited by Bodil Nielsen. Ibid.

consequence the lactic acid content in the blood was higher in the hot dry denditions[1]. While discussing about biochemical changes that take place at cellular level due to climatic variations, W.H. Osness[2] states that hundreds of chemical changes constantly occur in the body and that the rate of each of these reactions determine to a large extent its activity and that for every 10°F temperature rise, the rate of each reaction doubles, and therefore, temperature of the body is extremely important. He further states that the body is essentially a machine which is powered by enzymatic reactions, and enzymes are proteins and all proteins are heat labile. Therefore, the enzymes also require a certain thermal range to keep functioning. In view of this special property, it is obvious that the enzymes cannot sustain in high temperatures. Low temperatures will merely inhibit enzymes and metabolic processes, but high temperatures irreversibly destroy them by denaturing their constituent proteins. Thus the body seems to be able to handle cold temperatures better than hot temperatures.

While citing the study of Fepler, Lewis[3] states that physical activity taking place in high temperatures has a variable degree in the proficiency decrement, proportionate to the length of time of participation. An athlete may perform well for the greater part of a contest but show signs of both under tiring and lack of acuteness in co-ordination in the

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[1]C.G. Williams, et al. "Circulatory and Metabolic Reactions to work in Heat." Jour. of Applied Physiology. 17 : 625 (1962). Cited by Bodil Nielsen. Ibid.

[2]W.H. csness. "Temperature" (Heat, Cold and Indoor), An Article is Encycl. of Sports sciences and Medicine. (New York : The Macmillen Co. 1971) 869-70.

[3]W.E. Lewis. "Temperature." (Aretic, Moderate, Tropic) An Article is Encycl. Sports Sciences and Medicine. (New York : The Mecmillan Co. 1971) 123.

later time period. The same athlete, in temperatures of more comfortable range, could produce a higher value of efficiency for the entire period of contest. While concluding his best in temperatures that are comfortable to him and that acclimatization is an important asset in offsetting the effect of either heat or cold[1].

In physical activity the problem of dealing with extremely high temperature is more acute than that having to do with low temperature.

R. Cade, et al.[2] also conclude that heat stress is of major importance in limiting endurance exercise ability. They founding their experiment the decreased ability to perform endurance exercise at high temperatures, which they have compared with the studies made by Borden[3].

While discussing about the effect of environmental variations of energy cost of physical activity, Benister and Brown[4] state that the conditions producing heat or cold stress may elevate the energy expenditure values for activities above those usually obtained at thermally neutral ambient temperatures and humidity. Differences in environment may affect endurance, maximal aerobic capacity and heart rate. However, the changes in these parameters caused by environmental variations will depend upon individual difference in age, sex and physical fitness.

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[1]Ibid

[2]R. Cade, et al. "Effects of Fluid Electrolyte and Glucose Replacement during Exercise on Performance, Body Temperature, rate of sweat loss and compositional changes of Extracellular fluid." JSMPF 12 : 3 (September 1972) 150.

[3]D.L. Borden, et al. "Statistical Study of 265 cases of Heat Stress Disease." JAMA. 128 : 1200, 1945., cited by R. Cade, et al. Ibid., p. 155.

[4]E.W., Banister and S.R. Brown. "The Relative Energy Requirements of Physical Activity." Exercise Physiology. Ed. Harnold B. Falls, (New York : Academic Press, 1968) p. 312.

Martin et al.[1] (1977) feels that knowledge of these biorhythm patterns for the athletes could be extremely useful. They are interested in knowing themselves during their workouts and competitions. Observations of Martin et al. Suggest that the greater tendency for poor performance appears when the athletes give their performance during the positive phase of their emotional cycle. Similarly, performance times tended to be faster when runners were in the negative phase of their 20-day biorhythm patters. Joseph La Dou[2] (1980) uses the term circadium rhythms for those biorhythms that are synchroioned with the 24-hour light and dark cycle of the day. He further states that processes such as sleep, work etc. are attributed to the rhythms that are synchronized with light and dark cycles.

A. Emme[3] states that every biological process has a specific optimal temperature, which differs for the different organisms. Joseph La Dou[4] observes that temperature of our body steadily drops early in the morning and rises again late in the afternoon and early in the evening. He further observes that the body temperature rhythm of an athlete is particularly important.

Bleyer's[5] (1917) observations reveal that period from mid-summer to late fall as the period of acceleration of growth, winter a period of retardation, and spring and early summer a period of greater retardation.

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[1]Martin et al. Loc. cit.

[2]Joseph La Dou. "Circadian Rhythms And Athletic Performance. "T.T. 81 (Fall 1980) 2574.

[3] A. Emme. The Clock of Living Nature. (Moscow : Pèasce Publishers), p. 39.

[4] La Dou. loc. cit.

[5] A Bleyer, "Periodic variation in the Fate of Growth of Infants. "Archives of Pediatrics, XXXIV (May, 1917) 367. Cited in R.Q. 4 : 1, (March, 19633), 192.

In a study to find out influence of seasons on rate of growth of children L.E. Holt[1] and H. Feles (1925) observed that the rate of increase in growth from June to December exceeded that of December to June. There was the tendency towards a more rapid gain in the return months.

In comparing the seasonal growth of the children it was observed by Chaney[2] (1923) that the gain for each child during the winter period was greater in every case than was the gain in the spring.

W.T. Forter[3] (1920) shows the evidence of seasonal fluctuation in heights of school children. His data of eight years show, a maximal gain in the fall and early winter, and a period of minimal gain in the late spring and early summer.

Marshall[4] (1977) observes that a few children grow at a constant ratio throughout, the year and most being fastest in mid-winter and early spring, while it is slowest at mid-summer and early autumn. About body weight Marshall observes faster rate of growth in weight in the autumn.

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[1]L.E. Holt and H. Fales. "Health and growth of Children." American Journal of Diseases of Children, XXVI (July, 1933), 1 and on. Cited in R.Q. 4 : 1, (March, 1933); p. 180.

[2]M. Chaney. "A Comparison of the value of Mild and Organs as Supplementary Lunch for Underweight Children." American Journal of Diseases of Children, XXVI (October, 1923), 337 and on. Cited in R.Q. 4 : 1, (March, 1933); 192.

[3]W.T. Porter. "Seasonal Variation in Growth of Children." American Journal of Physiology, III(May, 1920), 121-131. Cited in R.Q. 4 : 1, (March, 1933); 189.

[4]W.A. Marshall. "Human Growth and its Disorders." Academic Press, New York. p. 119.

CHAPTER - 3

METHODOLOGY

CHAPTER III
METHODOLOGY

The experimental study conducted on school students to know that effect of seasonal variation on their athletic performance and motor ability is presented thereafter.

(1) Design of experiment : The experimental study was conducted on school students of Delhi City. Following procedure was adopted in the conduct of the experiment :

(a) Selection of Sample : About 150 students were selected randomly from the of Delhi Administration.

These schools were chosen for the following reasons:

(i) The schools were near the place of work and they were easy to approach.

(ii) The schools showed their preparedness for the participation of their students in the experiment.

(iii) Sufficient number of students could he obtained from these schools.

Students selected were from 9th to 17 years. A few students were above 17 age and below 20 years, except for one who was 23 years old. They wererepresenting a cross section of the population of different socio-economic status. While selecting the students,care was taken to avoid the handicapped and physically very weak students. Students of modorate and good health having interest in physical activities were given preference in the selection.

(b) Classification of the Students : It was earlier planned to keep all the selected students under close observations for more than oneyear and to record their performance in athletic events in different seasons of the year and also to repeat the same for the subsequent year. But only 40 students responded for the long term experimentation. It was further noted that these 40 studetns were not from a single school, but belonged to all the five schools named above. Remaining 110 students showed their preparaedness for experimentation during the period ofonly the acedemic seasion i.e. from middle of July to April most 1983, before commencement of their annual examination. Thus in the initial phase of the experiment, the student population wasdivided into two groups :

(1) group for long term experimentation.

(2) group for short term experimentation.

The selection procedure was completed by the middle of June 2004. The data concerning age, weight, and height of all the 150 selected students were collected. From this information Mecloy's classification Index was worked out for 145 students, on five students had expressed their inability tojoin the experiment for domestic purpose.This index has enabled the scrutiny of the students and further they could be equated for the purpose of analysis.

The following formula was applied to work out the index of each student :

$$20 \times \text{age} + 6 (\text{height} + \text{weight})$$

where, age is expressed in year, height in inches and weight in pounds. The students enrolled under long termexperimentation were brought under group "A". The remaining students of short Term

Experimentation were formed into 4 sub-groups namely B, C_1, C_2, C_3, groups were formed on the basis of the schools to whichthe students belonged, further, elimination of students had to be made because of their gross deviation from the mean index. Table-3.1 shows groupwise number of students before and after working out of classification Index:

TABLE-3.1
GROUPWISA NUMBER OF STUDENTS.

Group	Number of Students	
	Before Classification	**After Classification**
A	40	17
B	44	21
C_1	18	18
C_2	27	17
C_3	16	16
Total	145	99

The Table 3.1 clearly shows elimination of about 46 students for their gross diversion from the mean index. Finally, 145 students volunteered themselves for the entire period of experimentation. It has already been pointed out that only 17 students of Group A had volunteered for Long TermExperimentation. Table 3.1 gives Mecloy's classification index for various groups.

The average Mecloy's classification index for groups A, B, C_2 and C_3 ranged from 726, as shown in table 3.2. The average ages for the students in four groups varied from 15.40 to 16.22 years, while the weight and height ranged from 38.22 to 40.17 kg. and 57.30 to 62.24

inches respectively.

On the basis of this classification it was considered that sample of students selected for analysis was quite sound and satisfactory for further analysis. Somewhat lower indices of one or two stray students were ingored.

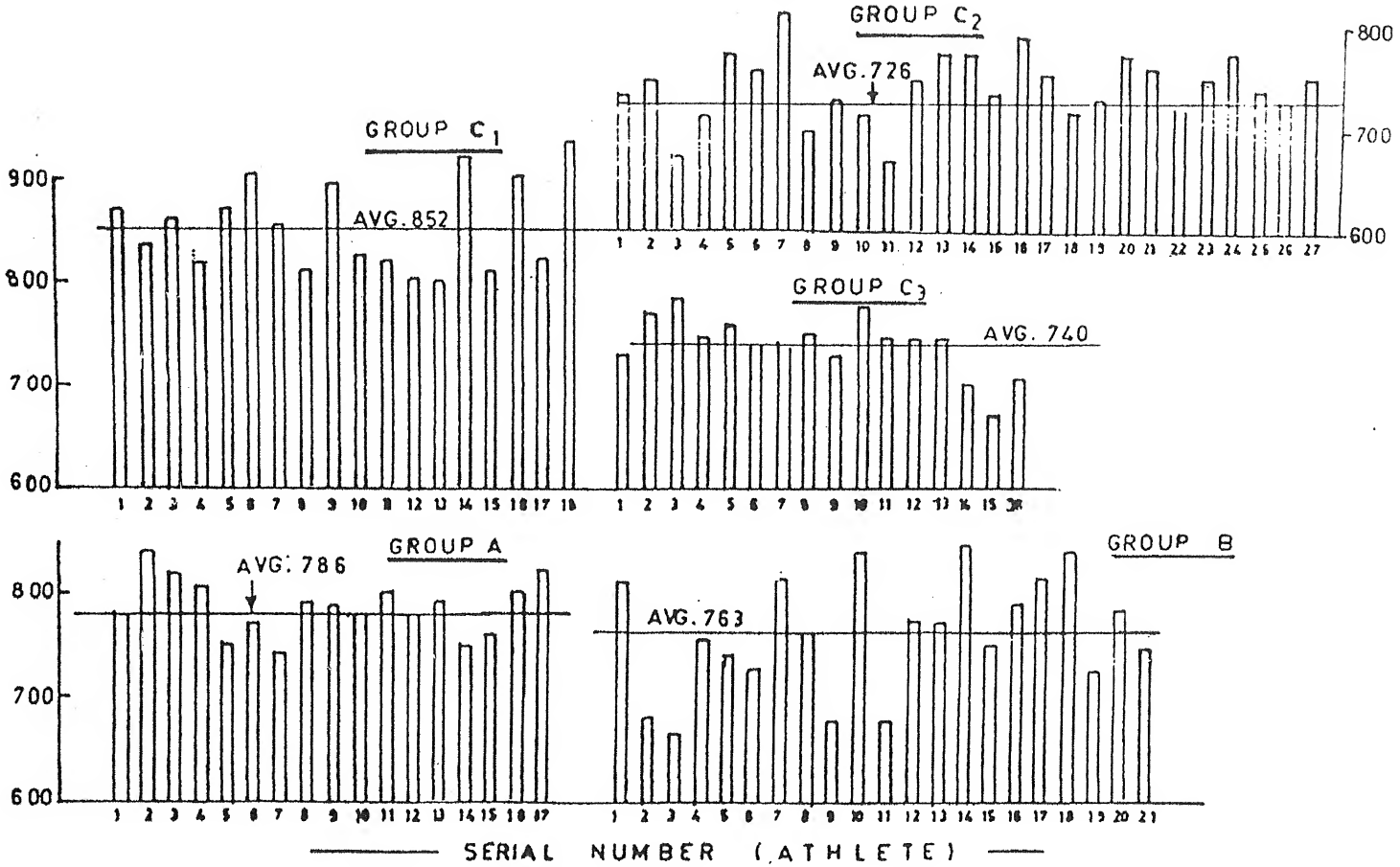
Group C_1 belonged to the average age group of 18.5 years which, therefore, had higher average index of 852 as compared with the other groups. However, the entire further analysis of the diferent groups was separated for further interpretation. Figure 3.2 plots the McCloy's classification index for each student finally selected for analysis.

TABLE-3.2

MCCLOY'S CLASSIFICATION INDEX FOR VARIOUS GROUPS

Group	No. of	Age (Years)			Weight (Kg.)			Height Inches)			KcCloy's Index		
	Students	Min	Max.	Ave	Min	Max	Ave	Min	Max	Ave	Min	Max	Ave
A	17	15.25	17.42	16.22	34	50	39.12	58	65	62.24	741	839	786
B	21	15.00	17.00	15.89	32	50	40.17	50	67	59.94	665	846	763
C_1	18	16.00	23.00	18.50	38	50	43.17	60	70	64.56	802	935	852
C_2	27	15.00	16.58	15.40	30	48	39.00	48	60	57.30	670	813	726
C_3	16	15.00	17.08	15.57	33	44	36.22	48	62	58.63	669	783	740

Figure 3.2
McCloy's Classification Index For Athletes
Selected For Experimental Study



Schedule of the Test Periods : The main object of study was to investigate the effect of seasonal variation on the performance level of athletes. The experiment was conducted on school students by observing their performance periodically in selected athletic events and motor ability factors. The testing dates for recording athletic performance of these students were scheduled according to the calender of (seasons).

Selection of Events : Of the several events in Track and Field, the following four events were selected for recording periodical performance of school students.

1. 100 Mtrs.
2. Putting the Shot
3. Running High Jump
4. Running Broad Jump.

All these four events are selected because of their simple nature. Any ordinary student can, with little practice, perform any one of these events. Other events like middle distance running, long distance running, javelin throw or pole vault and hurdles etc. are the events which require better coordination and longer hours of practice. With a few trials the students could attain considerable level of skill in events selected for the experiment. The events selected represent each area of Track and Field events viz. running, throwing and jumping.

In addition to these events, observations for these students were also recorded on following Motor Ability Factors from Sorrow Motor Ability Test[1].

---

[1]Barrow, H.M. and R. McGee : A Practical Approach to Measurement in Physical Education, 2nd Ed. (Philedelphia. Lea and Febiger. 1978). P. 157.

1. Medicine Ball for Strength

2. Zig-zag for Agility

3. Standing Broad Jump for Explosive power.

These observations were recorded in standard proforma as described in the procedure. This information was observed to investigate the effect of seasonal variations on motor ability factors as a support to the simultaneous variations in the athletic performance.

Procedure and Administration of Test : The procedure described below was followed in recording all the performances of the students in these events. Track and Field arena of the Degree College of Physical Education, Amravati, was the venue for conducting all the tests and recording athletic performance described hereunder :

A. ATHLETIC EVENTS

(i) 100 Mts. Run : In order to bring uniformity in the style, demonstration of taking the standing start on command of the clapper was given. Students were given free time to practice the standing start of race on the bang of clapper.

At the finish line, trained time-keepers of the college were appointed to record the time of incoming runners.

Three runners ran the race at a time, in three lanes and their timing was recorded to the nearest of second, by the time-keepers of respective lanes. All students were given only one chance to record their performance. However, sometimes students were asked to re-run the race either for committing the foul or due to fall by accident.

(ii) Putting the shot : Shot weighing 8 lbs. was used for the event throughout. Demonstration was given to the subjects regarding the

style of putting the shot. Detailed information was given to them, regarding the rules and regulations of the event. In order to bring uniformity in style, students were given free time of half an hour to practice the putting action.

Subjects were given three trails in rotation. The distance of shot put was measured correct upto 0.5 inches with standard procedure by trained teacher of the college, with the standard steel tape. The final score recorded was best of the three scores.

(iii) Running High Jump : High jump equipment like two side-posts and one triangular cross-bar were used for the event.

Demonstration with suitable explanation of three styles, vis. scissors, western roll and straddle roll was arranged before the event. Students were given ample time to practice the style of their choice. Actual performance of all the students was recorded by giving three chances on every height that was cleared. The height was increased inch by inch and was recorded in the record sheet by one trained assistant from the college staff.

(iv) Long Jump : As usual, the demonstration of an orthodox style in long jump was arranged and simple rules of the event were explained to the students. Sufficient time was given to all the students to practice the skill. Then the actual performance of all of them was recorded in rotation by giving three chances to each. All the three performances were measured correct upto 0.5 inch and the best performance of the three was finally considered. Standard method was used for measuring the distance of a jump. The foul jumps were eliminated and fouling students were given fresh chances to show their performances.

B. MOTOR ABILITY TEST FACTORS :

In addition to the recording of the performance of athletic events, observations on following motor ability factors for these students were also recorded :

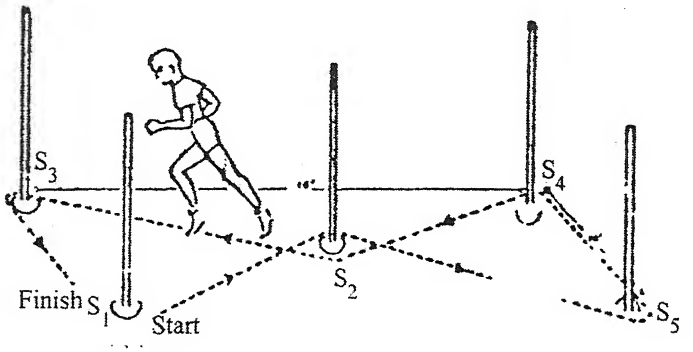
1. Zig Zag Run
2. 6 Pound Medicine Ball Put
3. Standing Broad Jump

These observations were made to investigate the effect of seasonal variations on motor ability factors a support to the simultaneous variations in the athletic performance. These three events were taken from the battery of Barrow Motor Ability Test.

Procedure : A brief description of the procedure that was followed for the conduct of each event is given here under :

(1) Zig Zag Run : The primary purpose of the event is to measure agility, the secondary purpose being the measurement of speed.

The course of Zig Zag Running was marked at the open ground on the rectangular plot measuring 10 × 16 feet. Five standards were erected (for which cricket stumps were used) in the pathway of running, with four at four corners of the rectangle and one standard at the centre of the rectangle, as shown in the figure.



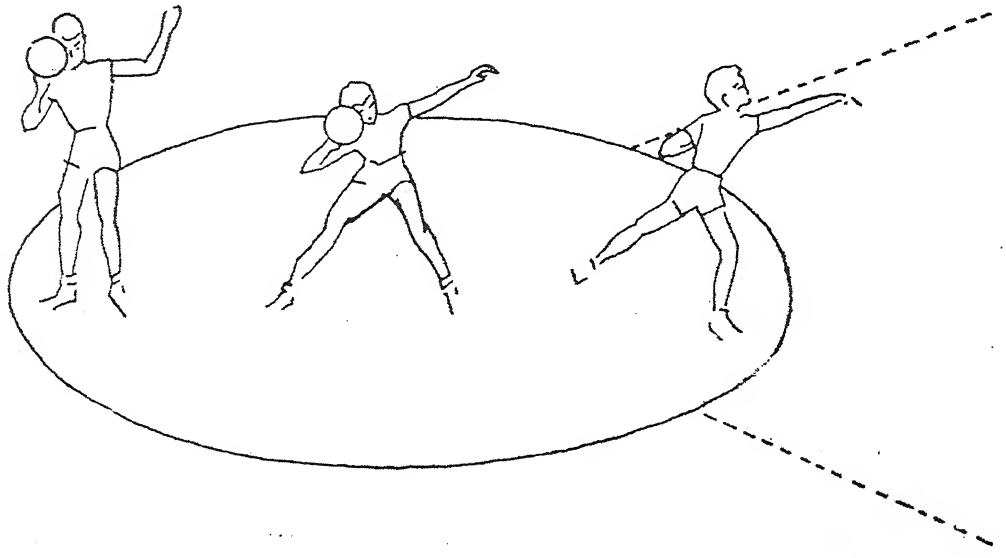
The Course for Zig Zag Running Stumps S_1, S_2, S_3, S_4, S_5

After giving a few trials and with final instructions, performance of all the subjects was recorded. For recording the timing a standard stop watch was used. The final score was the time elapsed to the nearest tenth of a second, which was required to run the prescribed course three times.

(2) Six Pound Medicine Ball Put : Primarily the purpose was to measure arm and shoulder girdle strength.

This event was conducted at the shot put sector. A Medicine Ball, weighing six pounds, was used.

Before starting of actual performance of the students, a demonstration was arranged with suitable explanation of the starting position, holding of ball, the putting action and the follow-through. Sufficient time was given to the students to practice the skill. Afterwards, actual performance was recorded.



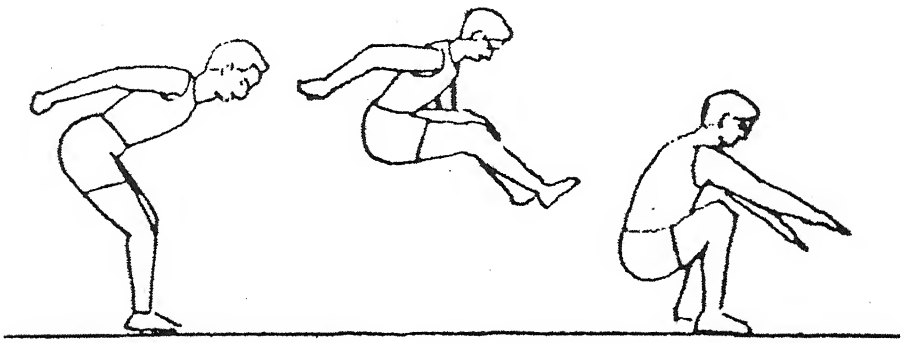
SIX POUND MEDICINE BALL PUT

While measuring the performance, the standard procedure that

is followed in the event of shot put, was used here. Each one was given three trials in succession. Could was counted as a trial but in the event that all three trials were fouls, the subject was asked to put until he made a fair put. All the three performances were measured to the nearest of an inch and the best performance of three was finally considered.

(3) Standing Broad Jump : The primary purpose of this event is to measure power, the secondary purpose being to measure agility, speed and strength.

Although a tumbling mat 5 × 12 feet is prescribed for the jump, the event was conducted on the broad jump pit. A takeoff board, which was flushed with the ground and a meter away from the pit, was used as a platform and its front edge as a starting line for jumping purpose. The subject was made to stand on this platform and with some initial swinging movements, he was asked to jump in the pit. After sufficient practice actual performance of the subjects was measured by giving three trials in succession, to each subject. The measurement of each jump was taken by the same method by which running broad jump was measured. The final score was the distance of the best jump measured to the nearest of an inch. In this way performance of all the subjects in standing broad jump was measured.



Standing Broad Jump.

C. BODY FAT

Equipment : Skinfold callipers

Procedure :

To obtain the data of body fat of each subject, skinfold measurements were taken at four selection sites of the body namely, Biceps, Triceps, subscapular and suprascapular iliac, which is showing fig.1

The procedure of taking measurement are described below :

i) Biceps thickness was measured with the help of skinfold callipers, which is shown in figure -2.

The subject stood by extending the right arm at right side a little. The arm was in relaxed position. A double layer of skin and subcutaneous tissue was grasped with the thumbs and fore fingers of the left hand over the biceps muscles on the front of the subjects. The skinfold calliper was placed gently into the grasped skin without removing the fingers and the thickness of the skin was recorded from the indicator needle of the dial. It was measured to the nearest millimeter.

ii) Triceps thickness of the subjects was measured with the help of skinfold calliper which is shown in figure-3.

The subjects stood by extending left arm down and elbow extended in relaxed position. A double layer of skin was grasped with the thumb and forefinger of the left hand over the triceps muscle on the back of the left arm, halfway between the acromion and elbow, where the skinfold runs parallel to the long axis of the arm. The skinfold calliper was placed gently into the grasped skin without removing the finger and

thickness of the skin was recorded from the indicator needle of the dial. It was measured to the nearest millimeter.

iii) Subscapular thickness was measured by using skinfold callipers, which is shown in figure.

The subjects stood with shoulder chest but relaxed and arm by the sides. A double layer skin and subcutaneous tissue was grasped with the thumb and the force finger of the left hand lateral to the inferior angle of the right scapula, where the skinfold runs downward and outward in the direction of the ribs. The skinfold calliper was placed gently into the grasped skin without removing the finger. The thickens of the skin was recorded as indicated by the indicator needle of the dial. It was measured to the nearest millimeter.

iv) Suprailiac thickness was measured with the help of skinfold callipers which is shown if figure.

The subjects stood in a normal erect position and were instructed to draw a median breath and hold it, while in the same position. A double layer of skin and subcutaneous tissues were grasped with the thumb and force finger of the left hand in a position one to two inches above the right anterior superior skinfold runs forward and slightly downward. The skinfold calliper was placed gently into the grasped skin without removing the finger and thickness of the skin was recorded from the indicator need of the dial. It was measured to the nearest millimeter.

CHAPTER - 4

ANALYSES AND INTERPRETATION OF DATA – TABLE 1 – 47

CHAPTER IV
ANALYSIS AND INTERPRETATION OF DATA

The statistical analysis of the data collected on 150 hundred female runners with respect to selected criterion measures namely body fat, endurance, and performance measured by skinfold caliper and test respectively are presented in this chapter. The data are furnished in appendix. The data were examined by one-way analysis of Variance1 for the four groups to ascertain the change in body fat, endurance, and performance biweekly within the group for training in various season. When the differences were found to be significant by one-way analysis of variable, the Scheffe's 'S' Post Hoc Test2 was applied to assess the significance of difference between paired means.

BODY FAT :

Findings with regard to each of the criterion measures have been enumerated separately.

Body Fat Change (After Two Weeks) :

Findings pertaining to the changes in body fat after two weeks of training in running go both the two control and two experimental groups are given below.

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[1]*H. Harrison Clarke and David H. Clarke, Advance Statistics with Application to Physical Education. Englewood Cliffs, N.J.: Prentice Hall Inc., 1972, p. 14.*

[2]*H.A. Scheffe, "A Method of Judging All Possible Covecasts in the Analysis of Variance". Biometrica 4(1953) : 87.*

TABLE-1

One Way Analysis of Variable For the Data on Body Fat changes of All The Four Groups After two Weeks of Training in Running

Sources of Variance	DF	SS	MSS	Obtained (F)	Required Fat.05 level
Between groups	3	13.5254	4.508	2.109@	2.704
Within	96	205.142	2.137		
N	=	100			

@Not significant at -.05 level of confidence.

An examination of Table-1, revealed that there was no significant difference in body fat changes after two weeks of training programme among the four selected groups at .05 level of confidence, as the F ratio of 2.109 obtained was lesser as compared to the required F .05 (3, 96) = 2.704.

Body Fat Changes (After Four Weeks of Training) :

One-way analysis of variance for the data on body fat changes after four weeks of training programme has been presented in Table-2

TABLE-2

One Way Analysis of Variable For the Data on Body Fat Changes of All The Four Groups After Four Weeks of Training Running

Sources of Variance	DF	SS	MSS	Obtained (F)	Required Fat .05 level
Between groups	3	50.1336	16.7112		
				9.593*	2.704
Within groups	...	96	1.672144		1.742

N = 100

*Significant at .05 level of confidence.

An examination of Table-2 revealed that there was a significant difference in body fat changes after four weeks of running programme among the four groups i.e. control group of summer season, experimental group (I) of summer, control group of winter season and experimental group (II) of winter, as the F ratio of 9.593 obtained was high as compared to the required F .05 (3,96) = 2.704.

Since the F ratio was significant Scheffe's 'S' Post Hoc Test was applied to test significance of differences between the paired means.

The mean and the difference between the paired means of body fat changes of all the four groups has been presented in Table-3.

TABLE-3

Difference between The Paired Means of The Four Groups of Body Fat Changes After Four Weeks of Running Programme

group B	group C_1	group C_2	group C_3	MD	CD
14.40	13.02			1.38*	1.062
14.40		14.95		.55	1.062
14.40			13.95	.45	1.062
	13.02	14.95		1.93*	1.062
	13.02		13.95	.93	1.062
		14.95	13.95	1.00	1.092

*Significant at -.05 level of confidence.

Table-3 indicates that the mean differences of 1.38 and 1.93 between the control group of summer season and the experimental group of summer season, and the control group of winter and the experimental group of summer season, are only significant as these values are greater than the confidence interval of 1.062 required for the mean difference to be significant at .05 level. Table further reveals that none of the other mean differences are significant as their values are considerably lower than the required confidence interval value.

Body Fat Changes (After Six weeks of Training) :

One way analysis of variance for the date on body fat changes after six weeks of training programme have been presented in Table 4.

TABLE-4
One Way Analysis of Variable For the Data on Body Fat Changes of All The Four Groups After Six Weeks of Training in Running

Sources of Variance	DF	SS	MSS	Obtained (F)	Required Fat .05 level
Between groups	3	115.1986	38.33		
				24.908*	2.704
Within groups	96	174.7665	1.54		
	N = 100				

*Significant at .05 level of confidence.

An examination of Table-4 revealed that there was a significant difference in body fat changes among the four groups after six weeks of training in running, as the F ratio of 24.908 obtained was high as compared to the required F .05 (3, 96) = 2.704.

Since the F ratio was significant, Scheffe's 'S' Post Hoc Test was applied to test significance of differences between the paired means.

The mean and the differences between the paired means of the four groups for the body fat changes after six weeks of training in running is presented in Table-5.

TABLE-5

Difference between The Paired Means of The Four Groups of Body Fat Changes After Six Weeks of Running Programme

group B	group C_1	group C_2	group C_3	MD	CD
14.62	12.26			2.36*	.999
14.62		15.01		.39	.999
14.62			13.48	1.14*	.999
	12.26	15.01		2.75*	.999
	12.26	13.48		1.22*	.999
	15.01		13.48	1.53*	.999

*Significant at .05 level of confidence

Table-5 indicates that the mean differences of 2.36, 1.14, 2.75, 1.22 and 1.53 between the control group and experimental group of summer, the control group of summer and the experimental group of winter, the control group of winter and the experimental group of summer, the experimental group of summer and the experimental group of winter, and the control group and the experimental group of winter, respectively are significant as these values are greater than the confidence interval of .999 required for the mean difference to be significant at .05 level of confidence. Table further reveals that there is no significant mean difference between the control group of summer and the control group of winter season as the .39 is considerably lower than the required confidence interval value of .999.

EXPERIMENTAL STUDY

The experimental study was limited to the following factors :

1. Subjects :

(a) Only the male students from the high school classes of the five schools were enrolled for this study. All the schools were from Delhi City alone, selected at random.

(b) The selected subjects head the sample of the students with varied socio-economic and family differences. Their health, fitness and nutritional status also had difference.

(c) Although the schools to which the subjects belonged were from Amravati City, the students from these schools had a mixed population of urban and rural students. The students selected for the experiment obviously represented this mixed population.

(d) Despite these differences, the subjects had a common pattern of school life and they had experienced this life for the lest 5 to 6 years. All the subjects selected for study were from 9th to 11th standard and were ranged from 15.40 to 18.5 years of age. The selected subjects were indulging in school sports earlier and even during the experimental period.

(e) The investigator did not have direct control over the subjects, compliance with the experimental procedures, especially in regard to their participation in additional physical activity.

2. Grounds :

(a) All the tests that were administered and the performances pertaining to athletic events and motor ability factors were recorded on the school.

(b) 400 Mtrs. cinder track and the athletic arena of the said school were used for the purpose. Since the college was a professional teachers' Training Institute of Physical Education, in general, condition of the track, and athletic arena was better than that of the similar school facilities.

3. Equipment :

All the equipments that were used during the conduct of test and for recording the performances, were borrowed from the Degree College of Physical Education, Amravati.

4. Time of Testing :

All the tests were conducted and performances recorded in the morning during 0.700 to 0.900 hours and in the evening during 1630 to 1800 hours.

5. Climatic Conditions :

The climatic conditions on the day of testing were different from test to test and were according to the existing season.

6. Volunteers :

Assistance of volunteers was sought in conducting the tests and recording the performances of the subjects in all the tests. The volunteers were from the teaching staff, and teacher-trainees of Degree College of Physical Education, Amravati, with ample background and training in conducting such tests.

ANALYSIS OF DATA

The experimental study has enabled to collect the data on two types of subjects.

1. Subjects used for long term experimentation (15 months).

2. Subjects used for short therm experimentation (9 months).

Long Term data were collected on 17 subjects comprising Group A, whereas the short term data were collected on 4 different groups namely, B, C_1, C_2, C_3 with number of subjects as 21, 18, 27 and 16 students respectively.

The data collected, mainly consisted of periodical performances of these groups in selected athletic events and motor ability factors, were recorded by standard procedure towards the end of each Rutu (season) of the year. There are six Rutus of the year. Group A was tested for six times and its performance in the above events was recorded for all the six Rutus and in addition to it, its performance was further observed in next three consecutive Rutus. Thus the tests performance of Group A was obtained for nine times during the course of 15 months. This performance was measured each time in four athletic events and three motor ability factors. During the entire period of experimentation (15 months) the meteorological data consisting of air temperature, humidity, barometric pressure of each day were also recorded.

In case of remaining four groups viz. B, C_1, C_2, C_3 the periodical performances in the four athletic events and three motor ability factors were noted from August 1982 to April 1983 i.e. for the period of nine months. Performances in seven different events were recorded five times in a span of 9 months. Meteorological date of all these 9 months were also collected.

The data thus collected for all the five groups were studied critically and then processed through statistical treatment with the object of knowing the following :

1. Eventwise position of athletic performance in different seasons of the year.
2. Effect of seasonwise fluctuation on athletic performance and motor ability factors.

With these objectives in view, necessary treatment was given to experimental data. Observations made and findings of the treatment given, are presented here below :

PERFORMANCE IN VARIOUS ATHLETIC EVENTS AND MOTOR ABILITY FACTORS

Tables 3.8 to 3.17 show the minimum, maximum and average scores for the four athletic events and three motor ability factors for the five groups of students A, B, C_1, C_2, C_3 being studied. The tables also show the range of variation and standard deviation for each Rutu. These data are graphically plotted in figures 6 to 10 to show the trend of variations in the minimum, maximum and average scores for all these events. In order to examine the association of these variations with the seasonal fluctuations, the air temperatures for these rutus are also plotted in the said graph side by side.

GROUP-A

TABLE-6

100 Meters Running Time in Seconds

Min		Max		Avg			Std.
Sec	m/s	Sec	m/s	Sec	m/s	Range	Dev. sec
15.5	6.45	20.0	5.00	17.35	5.76	4.5	1.28
16.0	6.25	21.5	4.65	18.18	5.50	5.5	1.43
16.0	6.25	20.0	5.00	18.21	5.49	4.0	1.15
15.7	6.37	17.2	5.81	16.45	6.08	1.5	0.62
14.2	7.04	17.1	5.85	15.64	6.39	2.9	0.77
13.9	7.19	16.5	6.06	14.78	6.76	2.6	0.76
12.5	8.00	14.2	7.04	13.35	7.49	1.7	0.64
13.1	7.63	15.2	6.58	14.22	7.03	2.1	0.53
13.0	7.69	16.1	6.21	14.78	6.77	3.1	0.71

Shot Put : Distance in Inches

Min	Max	Avg	Range	Std. Dev.
192	337	259.47	145	45.48
186	302	241.35	116	40.96
204	317	249.12	113	38.55
207	336	269.18	129	37.42
231	339	278.29	108	33.50
236	372	286.53	136	32.85
237	396	302.71	159	42.44
237	360	292.12	123	37.97
234	360	291.53	126	37.05

PERFORMANCE OF ATHLETIC EVENTS DURING DIFFERENT SEASONS

High Jump : Height in Inches

Min	Max	Avg	Range	Std. Dev.
24	50	36.65	26	6.43
28	45	38.35	17	6.03
33	45	39.29	12	4.92
33	51	42.06	18	5.50
42	52	44.94	10	5.09
44	54	47.24	10	4.12
45	56	49.53	11	4.34
42	56	47.71	14	4.52
42	54	46.76	12	4.15

Long Jump : Distance in Inches

Min	Max	Avg	Range	Std. Dev.
107	172	140.88	65	17.21
120	176	146.71	56	13.99
125	156	137.59	31	13.97
127	180	147.12	53	13.93
129	184	154.06	55	14.67
137	201	162.59	64	15.96
150	207	173.53	57	14.29
144	209	166.88	65	16.26
141	206	162.94	65	15.81

TABLE-7

Fluctuations in Motor Ability Factors during different Seasons

Zig-Zag Run

Min		Max		Avg			Std.
Sec	m/s	Sec	m/s	Sec	m/s	Range	Dev. sec
26.5	5.65	32.0	4.70	28.88	5.21	5.5	1.41
23.5	6.39	29.1	5.16	26.08	5.75	5.6	1.39
23.0	6.53	29.1	5.16	25.96	5.78	6.1	1.35
22.0	6.83	26.0	5.78	23.91	6.27	4.0	1.27
21.0	7.14	26.0	5.78	22.82	6.57	5.0	1.21
20.5	7.32	24.2	6.20	21.61	6.95	3.7	0.93
20.0	7.50	24.0	6.26	21.34	7.04	4.0	0.95
20.9	7.17	26.7	5.63	22.84	6.57	5.8	1.52
21.0	7.14	27.0	5.55	23.05	6.51	6.0	1.26

Medicine Ball Put (Inches)

Min	Max	Avg	Range	Std. Dev.
196	344	259.64	148	45.83
240	422	307.35	182	58.49
237	391	316.11	154	41.00
241	405	330.05	164	50.13
277	416	341.29	139	47.77
281	432	345.00	151	44.00
293	451	373.76	158	48.54
283	582	360.05	199	52.72
277	480	358.53	203	52.98

Standing Broad Jump (Inches)

Min	Max	Avg	Range	Std. Dev.
50	93	73.58	43	10.40
55	94	74.64	39	9.11
62	85	75.76	23	6.77
62	93	76.82	31	6.76
73	94	81.05	21	6.29
73	96	87.23	23	6.42
69	97	81.41	28	8.14
66	96	78.05	30	7.11

Note : The scores in seconds for zig-zag run are converted to meters per second (m/s) also.

GROUP-B

TABLE-8

Performance of Athletic Events during different Seasons

(1) 100 meters Running (2) Shot-Put (3) High Jump (4) Long Jump

100 Meters Running (Time in Seconds)

Min		Max		Avg			Std.
Sec	m/s	Sec	m/s	Sec	m/s	Range	Dev. sec
13.9	7.19	18.1	5.52	15.79	6.33	4.2	1.14
13.5	7.40	17.0	5.88	15.02	6.66	3.5	0.74
13.1	7.63	16.3	6.13	14.57	6.86	3.2	1.53
13.0	7.69	16.0	6.25	14.32	6.98	3.0	0.81
13.5	7.41	16.6	6.02	15.00	6.67	3.1	0.79

Shot Put (Inches)

Min	Max	Avg	Range	Std. Dev.
111	288	195.28	177	47.60
126	305	220.47	179	49.20
165	360	261.00	195	54.12
176	385	279.95	209	54.33
172	384	281.19	212	61.62

High Jump (Inches)

Min	Max	Avg	Range	Std. Dev.
30.0	44	37.80	14	3.88
32.0	46	39.47	14	3.95
36.0	50	42.57	14	4.80
36.0	52	44.38	16	4.96
33.0	51	42.57	18	5.05

Long Jump (Inches)

Min	Max	Avg	Range	Std. Dev.
78.0	165.0	129.85	87	20.20
98.0	180.0	139.23	82	21.44
107.0	178.0	146.19	71	19.50
108.0	193.0	152.42	85	21.67
103.0	186.0	147.61	83	19.82

TABLE-9

Fluctuations in Motor Ability Factors During different seasons

Zig-Zag Run

Min		Max		Avg			Std.
Sec	m/s	Sec	m/s	Sec	m/s	Range	Dev. sec
25.0	6.00	29.0	5.18	26.64	5.63	4.0	1.04
22.3	6.72	27.0	5.56	24.57	6.11	4.7	1.08
21.0	7.14	26.2	5.73	23.06	5.51	5.2	1.46
21.0	7.14	25.8	5.82	22.78	6.59	4.8	1.24
21.3	7.04	25.9	5.79	23.46	6.39	4.6	0.94

Medicine Ball Put (Inches)

Min	Max	Avg	Range	Std. Dev.
183	361	270.15	178	54.96
185	398	286.19	213	66.45
200	464	311.38	264	66.19
206	470	329.04	264	65.55
223	461	319.33	238	80.53

Standing Broad Jump (Inches)

Min	Max	Avg	Range	Std. Dev.
56	100	69.76	44	9.76
60	99	73.14	39	9.61
61	108	76.28	47	10.17
68	117	81.90	49	11.13
62	110	78.85	48	10.31

GROUP C_1

TABLE-10

Performance of Athletic Events during different Seasons

(1) 100 meters Running (2) Shot-Put (3) High Jump (4) Long Jump

100 Meters Running (Time in Seconds)

Min		Max		Avg			Std.
Sec	m/s	Sec	m/s	Sec	m/s	Range	Dev. sec
13.8	7.25	16.4	6.10	14.83	6.74	2.6	0.73
13.6	7.35	16.2	6.17	14.61	5.84	2.6	0.68
13.4	7.46	15.8	6.33	14.37	6.96	2.4	0.60
13.2	7.58	15.6	6.41	14.20	7.04	2.4	0.59
13.8	7.25	15.8	6.33	14.66	6.82	2.0	0.58

Shot Put (Inches)

Min	Max	Avg	Range	Std. Dev.
168	360	255.94	192	53.78
173	372	262.05	199	55.58
187	379	267.66	192	54.39
189	384	272.91	195	55.48
184	360	265.22	176	50.89

High Jump (Inches)

Min	Max	Avg	Range	Std. Dev.
30	51	39.72	21	5.96
30	53	41.38	23	6.29
33	53	42.83	20	5.45
36	54	43.77	18	5.03
36	52	42.55	16	4.34

Long Jump (Inches)

Min	Max	Avg	Range	Std. Dev.
119	180	144.33	61	18.64
126	184	149.22	58	18.23
129	192	153.33	63	18.72
133	205	158.50	72	19.50
132	204	153.66	72	18.78

TABLE-11

Fluctuations in Motor Ability Factors During different seasons

Zig-Zag Run

Min		Max		Avg			Std.	
Sec	m/s	Sec	m/s	Sec	m/s	Range	Dev.	sec
25.0	25.0	6.00	28.0	5.36	26.13	5.75	3.0	0.63
24.6	6.10	27.3	5.49	25.52	5.88	2.7	0.73	
24.3	6.18	26.7	5.69	25.05	6.00	2.4	0.70	
24.0	6.25	25.9	5.79	24.66	6.09	1.9	0.66	
24.0	6.25	27.3	5.49	25.28	6.00	3.3	0.76	

Medicine Ball Put (Inches)

Min	Max	Avg	Range	Std. Dev.
217	416	323.61	202	54.14
217	421	332.72	204	54.82
243	446	353.38	203	56.89
252	444	359.22	192	56.34
240	435	352.05	195	55.84

Standing Broad Jump (Inches)

Min	Max	Avg	Range	Std. Dev.
58	88	74.83	30	8.57
60	90	77.11	30	8.56
66	91	81.22	25	8.05
72	93	84.38	21	6.00
69	90	81.38	21	6.52

GROUP C_2

TABLE-12

Performance of Athletic Events during different Seasons

(1) 100 meters Running (2) Shot-Put (3) High Jump (4) Long Jump

100 Meters Running (Time in Seconds)

Min		Max		Avg			Std.
Sec	m/s	Sec	m/s	Sec	m/s	Range	Dev. sec
16.5	6.06	19.7	5.08	17.84	5.61	3.2	0.95
14.0	7.14	19.0	5.26	16.08	6.22	5.0	1.22
14.0	7.14	17.8	5.62	15.75	6.35	3.8	1.08
13.8	7.25	17.5	5.71	15.57	6.42	3.7	1.02
14.4	6.94	18.4	5.43	16.51	6.06	4.0	1.04

Shot Put (Inches)

Min	Max	Avg	Range	Std. Dev.
140	327	222.00	187	41.57
182	389	243.81	207	44.15
201	417	273.92	216	54.91
204	364	284.11	160	52.79
190	361	271.00	171	47.92

High Jump (Inches)

Min	Max	Avg	Range	Std. Dev.
39	51	47.11	12	3.91
89	55	48.92	16	4.41
41	54	50.37	13	3.20
43	56	51.74	13	3.71
43	56	50.29	13	3.47

Long Jump (Inches)

Min	Max	Avg	Range	Std. Dev.
118	165	137.62	47	13.63
120	180	147.74	60	17.98
121	195	149.37	74	19.73
120	204	154.33	84	19.33
120	189	147.77	69	18.02

TABLE-13

Fluctuations in Motor Ability Factors During different seasons

Zig-Zag Run

Min		Max		Avg			Std.
Sec	m/s	Sec	m/s	Sec	m/s	Range	Dev. sec
23.5	6.37	26.0	5.78	24.65	6.09	2.5	0.69
22.0	6.77	26.0	5.78	23.09	6.50	4.0	0.81
22.0	6.77	24.0	6325	22.72	6.60	2.0	0.55
22.0	6.77	23.7	6.33	22.48	6.68	1.7	0.49
22.7	6.62	26.1	5.75	24.22	6.20	3.4	0.78

Medicine Ball Put (Inches)

Min	Max	Avg	Range	Std. Dev.
222	401	284.48	179	46.91
218	433	301.81	215	49.81
245	382	308.14	137	39.81
247	480	318.44	233	52.79
240	459	313.48	219	50.83

Standing Broad Jump (Inches)

Min	Max	Avg	Range	Std. Dev.
54	86	69.62	32	7.90
60	91	76.96	31	8.10
55	98	80.63	43	10.08
56	103	84.25	47	9.75
50	98	78.48	48	9.90

GROUP C_3

TABLE-14

Performance of Athletic Events during different Seasons

(1) 100 meters Running (2) Shot-Put (3) High Jump (4) Long Jump

100 Meters Running (Time in Seconds)

Min		Max		Avg			Std.
Sec	m/s	Sec	m/s	Sec	m/s	Range	Dev. sec
14.2	7.04	18.2	5.49	16.38	6.11	4.0	1.06
14.0	7.14	18.0	5.56	16.20	6.17	4.0	1.05
14.0	7.14	17.4	5.75	15.92	6.28	3.4	1.01
13.9	7.19	17.4	5.75	15.75	6.35	3.5	1.02
14.1	7.09	18.0	5.56	16.12	6.20	3.9	0.98

Shot Put (Inches)

Min	Max	Avg	Range	Std. Dev.
132	255	183.00	123	33.09
155	264	190.68	109	33.60
146	268	193.68	122	35.03
148	260	197.13	112	28.70
149	247	195.50	98	28.40

High Jump (Inches)

Min	Max	Avg	Range	Std. Dev.
32	47	41.62	15	4.74
32	49	43.00	17	5.11
34	50	44.25	16	4.56
37	50	45.68	13	3.96
36	49	44.37	13	4.46

Long Jump (Inches)

Min	Max	Avg	Range	Std. Dev.
78	144	115.43	66	16.87
88	147	120.93	59	16.06
97	156	127.00	59	16.39
102	168	134.00	56	15.81
104	163	132.81	59	13.12

TABLE-15

Performance in Motor Ability Factors During different seasons

Zig-Zag Run

Min		Max		Avg			Std.
Sec	m/s	Sec	m/s	Sec	m/s	Range	Dev. sec
25.5	5.88	29.0	5.18	26.69	5.63	3.5	0.93
25.0	6.00	28.0	5.36	26.16	5.73	3.0	0.96
23.7	6.33	27.8	5.40	25.56	5.87	4.1	0.89
23.4	6.40	26.8	5.60	25.00	6.00	3.4	0.84
24.0	6.25	27.0	5.55	25.51	5.88	3.0	0.75

Medicine Ball Put (Inches)

Min	Max	Avg	Range	Std. Dev.
152	351	242.12	299	71.45
157	312	240.62	151	47.08
175	366	251.18	191	52.21
180	375	255.12	195	52.76
175	372	250.68	197	52.76

Standing Broad Jump (Inches)

Min	Max	Avg	Range	Std. Dev.
50	81	66.84	31	6.84
52	85	69.56	33	7.27
56	88	72.31	32	7.54
59	90	75.06	31	6.65
60	89	71.76	29	6.48

The salient features of the variations are discussed below for each of the athletic events and motor ability factors.

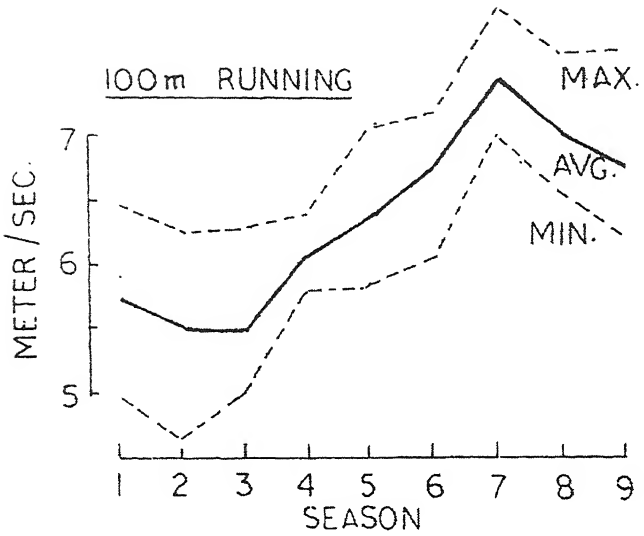
A. PERFORMANCE IN ATHLETIC EVENTS

1. 100 Meters Running : Performance in 100 Meters Running was measured periodically for all the five groups. In case of Group A, the performance was recorded for nine times as shown in Table-6. It is observed from the table that the average time in seconds for 100 meters running varied from 12.5 seconds in shishir vasant Rutu to 21.5 seconds in vasant grishma Rutu. This indicates substantial fluctuation in the performance level in various Rutus.

These scores are converted to meters per-second for comparison with the trends of other events and motor ability factors with Rutus. Converted scores to meters per-second indicate a speed of 5.76 meters per-second in the beginning which in vasant-grishma has gone down to 5.50 meters per second and further decreased to 5.49 in Grishma-Varsha. But, afterwards there seems to be gradual improvement in the performance with a maximum reached to 7.49 meters in Shishir-Vasant Rutu (i.e. in the month of February). Performance of this group was further recorded in Vasant and Grishma Rutu i.e. (in May 1983). After reaching peak performance of 7.4 meters in Shishir-Vasant the group showed decline in its performance in Vasant as well as in Grishma (7.03 M/s and .7 M/s respectively).

A graphical representation of the performance in 100 meters running in different seasons is shown in figure.

GROUP-A



Seasonwise Performance in 100 Meter Running.

The performances of the remaining 4 groups vis. B, C_1, C_2 and C_3 were recorded from August (i.e. Varsha-Sharad) and with the interval of two months, performances were recorded upto April 1983 (i.e. Vasant-Rutu). The Table shows seasonwise performance of each group in 100 Meters with maximum and minimum range of individual scores.

TABLE-16

Average timing of each group in successive periods of testing (Seasonwise) and Range of individual timing in each group.

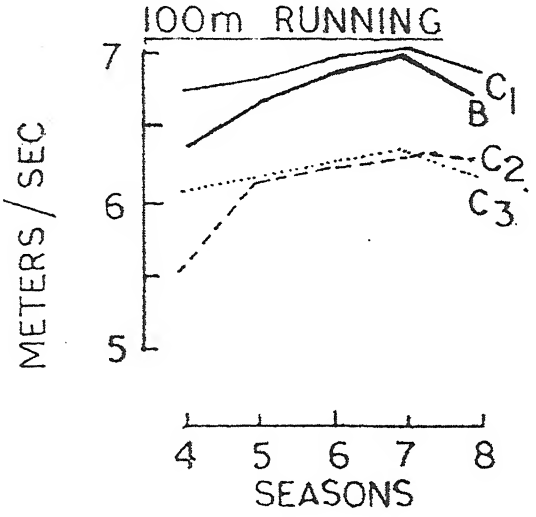
S. No.	Groups No. of Students	Periods of Testing					Range of individual Timing
		Varsha Sharad	Sharad Hemant	Hemant Shishir	Shishir Vasant	Vasant Rutu	
1.	B	15.79	15.02	14.57	14.32	15.00	13.0 to
	(n = 21)	(6.33)	(6.66)	(6.86)	(6.98)	(6.67)	18.1
2.	C_1	14.83	14.61	14.37	14.20	14.66	13.2 to
	(n = 18)	(6.74)	(6.84)	(6.96)	(7.04)	(6.82)	13.8)
3.	C_2	17.84	16.08	15.75	15.57	16.51	13.3 to
	(n = 27)	(5.61)	(6.22)	(6.35)	(6.42)	(6.06)	19.7
4.	C_3	16.38	16.20	15.92	15.75	16.41	13.9 t
	(n = 16)	(6.11)	(6.17)	(6.28)	(6.35)	(6.20)	18.2

Note : 1 figures in bracket indicate average timing of the group in meters-per-second.

It may be observed from the Table-16 that all the four groups have clocked maximum timing at the first instance (i.e. in Varsha-Sharad) Rutu. Then in subsequent Rutus there appears a gradual improvement in the performance and, the best performance by all the four groups was recorded in Shishir-Vasant (i.e. month of February 1983). The next performance recorded in the month of April (i.e. in Vasant-Rutu) indicates decreases in performance level in all the four groups.

Like group "A" the scores of remaining four groups were also converted in M/s. These values are shown in the above table No. 16 with figures in bracket.

It is evident from the table that the average performance of each group Meters per-second appears to have increased in each successive period of testing, the maximum being in the month of February. With the starting of Grishma (i.e. the month of April) the performance clearly shows a descending trend invariably in all the four groups.



Seasonwise average performance of the remaining four groups in 100 Mts. Running (Meters-per-second).

2. Shot Put : Performance in shot put was recorded for nine times in case of Group A.

TABLE 17

Shot Put : Performance of Group A during Different Seasons.

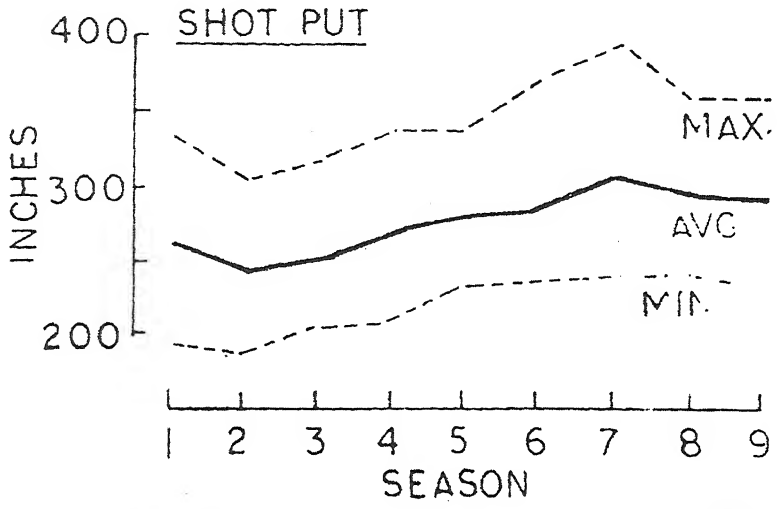
Performance - length in inches				
Min	**Max**	**Avg**	**Range**	**Std. Dev.**
192	337	259.47	145	45.48
186	302	241.35	116	40.96
204	317	249.12	113	38.35
207	336	269.18	129	37.42
231	339	278.29	108	33.50
236	372	286.53	136	32.85
237	396	302.71	159	42.44
237	360	292.12	123	37.97
234	360	291.53	126	37.05

In a span of 16 months the group was tested in putting the shot for nine times. A careful observation of the Table - 17 reveals that there is a gradual and consistent rise in performance from second to seventh test. The first performance was recorded in Shishir-Vasant in February. The second was recorded in the March i.e. month of May. Here, the performance has gone down by 18.12 inches. It may be noted here that the decrease in performance is observed in Grishma Rutu (i.e. month of May). But in subsequent Rutus, the performance shows ascending trend reaching maximum to 302.71 inches in Shishir-Vasant (i.e. month of February). Then a descending trend is observed in performance in remaining two Rutus (i.e. in Vasant and Grishma April and May, months respectively).

The starting performance in shot put was 250.47 inches. It

decreased to 241.35 in Vasant Grishma, then consistently increased to reach to maximum i.e. 302.71 in Shishir-Vasant (February) without any training. As the summer approached, the performance showed descending trend again.

A graphical presentation of the performances of Group A in shot put event is shown in figure.



Seasons Performances of Group A in Shot Put.

Performance of Group B, C_1, C_2 and C_3 in putting the shot were recorded in five different seasons i.e. from August to May.

In a span of 9 months all the four groups showed the same pattern in respect of their performance in shot put, as is evident in case of Group "A".

The Table-18 shows average performances with standard deviations of the four groups in shot put event during different seasons.

TABLE-18

Shot Put Standard Deviation and Means of Performances of four Groups in different seasons. (Figures indicate length in inches. Figures in brackets indicate standard deviation.)

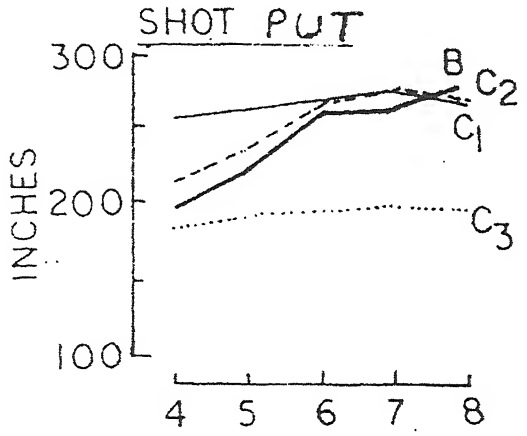
S. No.	Groups No. of Students	Periods of Testing				
		Varsha Sharad	Sharad Hemant	Hemant Shishir	Shishir Vasant	Vasant Rutu
1.	B	195.28	220.47	261.00	279.95	281.19
	(n = 21)	(47.60)	(49.20)	(45.12)	(54.33)	(61.62)
2.	C_1	255.94	262.05	267.66	272.94	265.22
	(n = 18)	(53.78)	(55.58)	(54.39)	(55.48)	(50.89)
3.	C_2	222.00	243.81	273.92	284.11	271.00
	(n = 27)	(41.57)	(44.15)	(54.91)	(52.79)	(47.92)
4.	C_3	183.00	190.68	193.68	197.13	195.50
	(n = 16)	(33.09)	(33.60)	(35.03)	(28.70)	(28.40)

It was observed in the performance assessment of Group A in shot put that with the initial setback to performance in Grishma, there was a continuous rise in the performance upto Shishir-Vasant 1983. Then there was a continuous decline in performance with the onset of Grishma.

Here also the same trend is evident in the periodical performance of the three groups except one. The starting performance of all the four groups was recorded in August (Varsha-Sharad Rutu) and since then an ascending trend is observed in performance till February 1983 (Shishir-Vasant Rutu). The peak performance was observed in February, in last three groups, and soon after the Vasant Rutu, with the onset of Grishma, the performance of the last three groups second to have declined.

However, performance of group B showed a slight rise by 1.24 inches even in the month of April.

The graph in figure shows periodical performance of all the 4 groups in shot put during different seasons of the year :



Performances of four groups in Shot Put

Further, attempt was made to calculate the average rate of improvement in a span of first 6 months and that between 3rd and 4th period of testing. It was revealed that the average rate of improvement between first and fourth period of testing i.e. from August to February was 44.48 inches. The rate of improvement between 2nd and 3rd period of testing seemed to be greater (average 19.81 inches) than that of the first and second period of testing and also the third and fourth period of testing (1st and 2nd average rate of increase 15.19 inches and 3rd and 4th average rate of increase 9.46 inches).

Then the difference between 4th and 5th period of testing was calculated, it was revealed that the average performance of all the 4 groups was decreased by 07.073 inches. This decline in the performance towards the starting of Grishma is also evident in the performance of Group "A".

3. High Jump : Like the earlier two events the performance of Group "A" in Running High Jump was recorded for nine times in different seasons of the year. The minimum and maximum performance at each time, with mean, standard deviation and range are presented in Table-19.

TABLE-20
Performance of Group "A" in Running High Jump During Different Seasons.

S. No.	Rutu and Date	Performance - length in inches				
		Min	Max	Avg	Range	S. D.
1.	Shishir-Rutu	24	50	36.65	26	6.43
2.	Vasant-Grishma	28	45	38.35	17	6.03
3.	Grishma-Varsha	33	45	39.29	12	4.92
4.	Varsha-Sharad	33	51	42.06	18	5.50
5.	Shared-Hemant	42	52	44.94	10	5.09
6.	Hemant-Shishir	44	54	47.24	10	4.12
7.	Shishir-Vasant	45	56	49.53	11	4.34
8.	Vasant-Rutu	42	56	47.71	14	4.52
9.	Grishma	42	54	46.76	12	4.15

It is observed from the Table-20 that the mean performance shows continuous ascending trend during the first seven tests. At the initial stages the mean performance was 36.65 inches which at the seventh test climbed to the extent of 49.53, in the month of February (Shishir-Vasant Rutu).

The improvement of about 12.88 inches was remarkable in a span of 12 months without any training. Another observation from the table, is that, there is no setback to the mean performance in Vasant - Grishma of 1982, soon after the first initial performance that was recorded

in Shishir - Rutu (15-2-1982). The mean performance of Vasant - Grishma in 1982, shows a slight improvement of 1.70 inches.

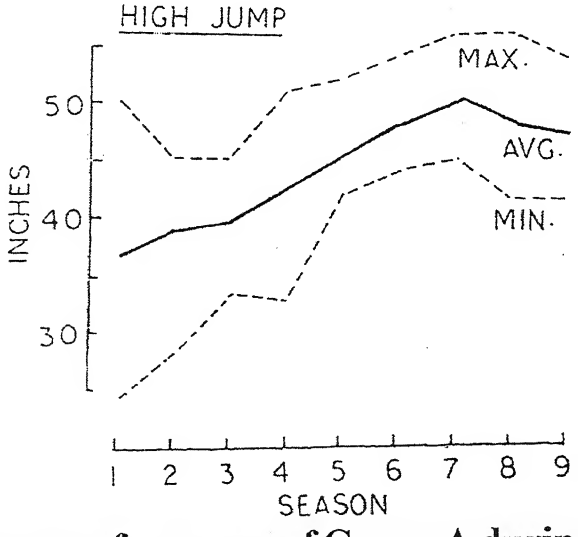
However, the maximum and minimum values of individual performance, as per the table, show slightly a different picture.

The maximum performance at the time of second testing shows decrease by 5.00 inches. In the first testing maximum value was 50.00 inches, but during the second testing i.e. in Vasant-Grishma, it came down to 45.00 inches.

The value of minimum performance in High Jump shows ascending trend for first seven tests, but during the last two seasons i.e. in Vasant and Grishma and there appears decrease in the same.

The mean performance reaches to its peak of 49353 inches in Shishir-Vasant. But then there appears decrease in mean performance during the two subsequent Rutus. The last performance was taken in Grishma and it showed decrease in performance by 2.77 inches in a span of four months. Here, the effect of Grishma Rutu on performance level is evident.

A graphical representation of the periodical performance is shown in figure.



High Jump-performance of Group A during different seasons of 1982-83

The performance of other four groups viz. B, C_1, C2, C3 in high jump was recorded in five different Rutus i.e. from Varsha-Sharad to Vasant-Rutu. The same date with the mean of performance along with standard deviation in respect of each group are presented in the table-21.

It may be noted from the table-21 that the performance of all the four groups shows ascending trend during second, third and fourth period of testing. There is increase in performance on an average by 5.8 inches in all the four groups in a span of six months. These six months fall in Visarga Kal, that is cooler season of the year. When performance

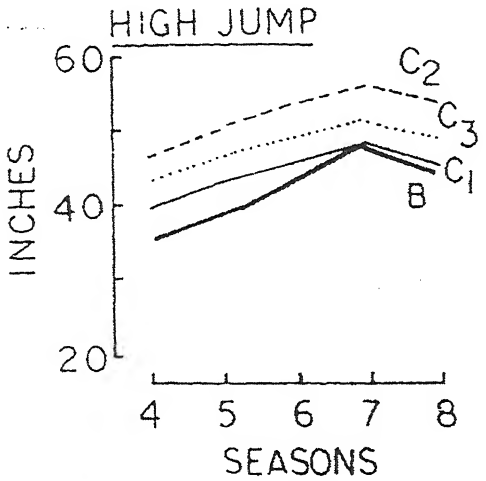
TABLE-21

High Jump : Standard deviations and means of performance of the four groups during different seasons. (Figures indicate height in inches. Figures in brackets show standard Deviation)

S. No.	Groups No. of Students	Periods of Testing				
		Varsha Sharad	Sharad Hemant	Hemant Shishir	Shishir Vasant	Vasant Rutu
1.	B	37.80	39.47	42.57	44.38	42.57
	(n = 21)	(3.88)	(3.05)	(4.80)	(4.96)	(5.05)
2.	C_1	39.72	41.38	42.83	43.77	42.55
	(n = 18)	(5.96)	(6.29)	(5.45)	(5.03)	(4.34)
3.	C_2	47.11	48.92	50.37	51.74	50.29
	(n = 27)	(3.91)	(4.41)	(3.20)	(3.71)	(3.47)
4.	C_3	41.62	43.00	44.25	45.68	44.37
	(n = 16)	(4.74)	(5.11)	(4.56)	(3.96)	(4.446)

was the year. When performance was recorded on it showed a descending trend with an average reduction of 1.44 inches in respect of all the four groups, in a span of 2 months only. The peak performance of all the four groups was marked in Shishir-Vasant. The average rate of increases in performance between 3rd and 4th period of testing was calculated to 1.38 inches. As compared to the average rate of increase between 3rd and 4th period of testing, the average rate of reduction in performance between 4th and 5th is also quite sharp.

The figure is the graphical presentation of the performances of all the four groups during different seasons.



High Jump-performances of four groups in different seasons.

4. Long Jump : The periodical performance of Group "A" in Running Long Jump during the span of 15 months, also like earlier events, shows an ascending trend upto the seventh period of testing where the performance of the group reaches maximum. However, performance shows slight depression during the 3rd period of testing. There is again a period of depression and a clear indication of a descending trend in

performance during 8th and 9th period of testing. The average performance of each period with maximum and minimum and range with standard deviation in respect of performance of Group A in different Rutus is presented in Table-22.

TABLE-22

Long Jump : Performance of Group "A" during different seasons.

S. No.	Rutu and Date	Performance - length in inches				
		Min	Max	Avg	Range	S. D.
1.	Shishir-Rutu	107	172	140.88	65	17.21
2.	Vasant-Grishma	120	176	146.71	56	13.99
3.	Grishma-Varsha	125	156	137.59	31	13.97
4.	Varsha-Sharad	127	180	147312	53	13.93
5.	Shared-Hemant	129	184	154.06	55	14.67
6.	Hemant-Shishir	137	201	162.59	64	15.96
7.	Shishir-Vasant	150	207	173.53	57	14.29
8.	Vasant-Rutu	144	209	166.88	65	16.26
9.	Grishma	141	206	162.94	65	15.81

The average long jump score ranged from 137.59 inches in Grishma-Varsha Rutu to 173.53 inches in Shishir-Vasant.

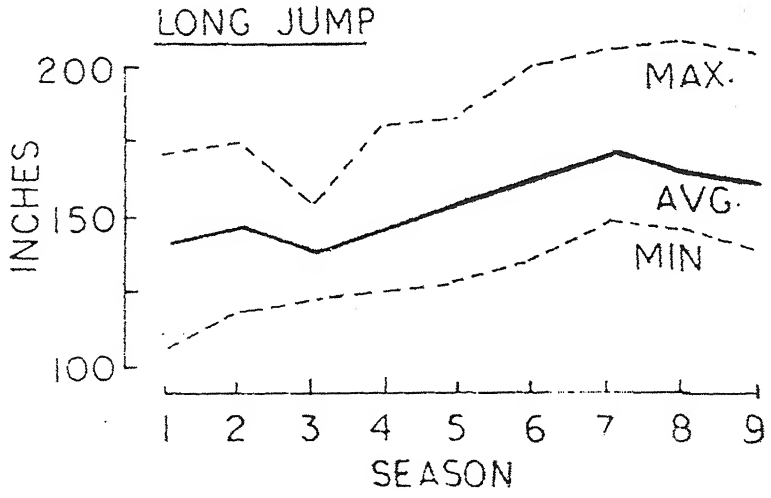
The individual score fluctuated from 120 inches in Vasant-grishma to 209 inches in Vasant-Rutu. The score of 107 in the initial performance test was not considered.

Further, it may be noted from the Table-22 that there is a rise

of about 32.65 inches in the performance of group "A" in a period of 12 months i.e. from 1st to 7th period of testing. The maximum performance of 173.53 was noted at the time of 7th testing in the month of February. The last two performances were recorded in April and May and on both the occasions, the performance had gone down by 10.59 inches. The temperature chart in shows considerable rise in air temperature during these two periods of testing when the performance was showing the descending trend.

During earlier periods of testing with the onset of Grishma the third test was conducted in the month of June when performance recorded was at its lowest ebb. figure shows a graph depicting periodical performance of Group A in Long Jump.

The remaining four groups were tested five times in long jump in a period of nine months. Table-23 presents S.D. and Means of the performances of the four groups during different periods of testing.



Periodical performance of group A in long jump.

TABLE-23

Long Jump : Standard Deviation and Means of the performance of the four groups during different Seasons.

S. No.	Groups No. of Students	Periods of Testing				
		Varsha Sharad	Sharad Hemant	Hemant Shishir	Shishir Vasant	Vasant Rutu
1.	B	129.85	139.23	146.19	152.42	147.61
	(n = 21)	(20.20)	(21.44)	(19.50)	(21.67)	(19.82)
2.	C_1	144.33	149.22	153.33	158.50	153.66
	(n = 18)	(18.64)	(18.23)	(18.72)	(19.50)	(18.78)
3.	C_2	137.62	147.74	149.37	154.33	147.77
	(n = 27)	(13.63)	(17.98)	(19.73)	(19.99)	(18.02)
4.	C_3	115.43	120.93	127.00	134.00	132.81
	(n = 16)	(16.87)	(16.06)	(16.39)	(15.81)	(13.12)

It is evident from the table-23 that after the initial performance in August, all the four groups show increase in their performance every time during 2nd, 3rd and 4th periods of testing. This gradual and continuous increase is observed when the testing was done from Varsha-Sharad in August to Shishir-Vasant in February 1983. Further observations reveal that the performance of all the four groups seemed to have decreased during the 5th period of testing which was held in Vasant-Rutu.

The mean difference in performance of all the 4 groups in between two different periods of testing was calculated. The maximum increase in performance by 18.00 inches was observed between 1st and 2nd periods of testing was 7.48 inches and that, between 2nd and 3rd period of testing was 4.69 inches.

It appears from the table-24 that the difference between 1st and 2nd periods of testing is comparatively greater than that between the 2nd and 3rd periods of testing and also that between 3rd and 4th periods of testing. However, the maximum performance was recorded only in 4th period of testing.

S.No.	Period of	Mean Difference	Remarks
1.	1st and 4th periods	18.00	Increase in Performance
2.	1st and 2nd Periods	7.48	Increase in Performance
3.	2nd and 3rd periods	4.69	Increase in Performance
4.	3rd and 4th periods	5.84	Increase in Performance
5.	4th and 5th periods	–4.35	Decrease in Performance

The table further shows the difference between 4th and 5th periods of testing by 3.48 inches. Here the performance in 5th test was lesser than in the 4th test. The performance decreased by 3.48 inches with the onset of Grishma Rutu in April.

B. MOTOR ABILITY FACTORS :

With a view to the fair comparison between the two variables, periodical performances of all the five groups were recorded in motor ability factors along with the athletic events.

Analysis of the collected data of the motor ability factors in presented below :

1. Zig-Zag Run : Performance of Group 'A' in this event was recorded in seconds for 9 times at seasonal intervals. The maximum and minimum performance with average and range as well as standard Deviation of the performance at each interval are presented in Table-25

TABLE-25
Zig Zag Run : Performance of Group A

S. S. No.	Rutu and	Min		Max		Avg		Range	Std. Dev.
		Sec	m/s	Sec	m/s	Sec	m/s	Sec	Sec
1.	Shishir Rutu	26.5	5.65	32.0	4.70	28.88	5.21	5.3	1.41
2.	Vasant-Rutu	23.5	6.39	29.1	5.16	26.08	5.75	5.6	1.39
3.	Grishma-Varsha	23.0	6.53	29.1	5.16	25.96	5.78	6.1	1.35
4.	Varsha-Shared	22.0	6.83	26.0	5.78	23.91	6.27	4.0	1.27
5.	Sharad-Hemant	21.0	7.14	26.0	5.78	22.82	6.57	5.0	1.21
6.	Hemant-Shishir	20.5	7.32	24.2	6.20	21.61	6.95	3.7	0.93
7.	Shishir-Vasant	20.0	7.50	24.0	6.26	21.34	7.04	4.0	0.95
8.	Vasant-Rutu	20.9	7.17	26.7	5.63	22.84	6.57	5.8	1.52
9.	Grishma	21.0	7.14	27.0	5.55	23.05	6.51	6.0	1.26

The timing that was recorded at each period of testing shows a descending trend upto 7th period. On each occasion average timing to the event seemed to have gone down. The initial timing of the group was 28.88 sec. Which at the time of the 7th test had come down to 21.34 seconds. After 7th period of testing the Vasant and Grishma Rutu start in the month of April and May, where the performance level seemed to have gone down.

The performance in this event was best (21.34 sec) in Shishir-Vasant and poorest i.e. 28.88 seconds at the beginning. The individual score ranged from 20.00 to 32.00 seconds.

When the performance scores in seconds were converted to Mtrs. per second it was observed that this converted score also had an ascending order upto 7th test and then the 8th and 9th test had shown decrease in the score. It shows a sign of fall in the performance level. The average speed counted in Mtr. per second to have decreased during the last two periods of testing.

It is, therefore, very much clear that the performance during the winter spell shows periodical improvement and with the advent of summer (Grishma) that performance goes down.

Timings of Zig Zag run in different seasons of testing in case of remaining four groups viz. B, C_1, C_2, C_3 also show the trend that was observed in the performance of Group A. The timings were recorded for five times from August 1982 to April 1983 with the interval of two months. All the four groups show a similar behaviour in respect of their performance in Zig Zag Run. From the initial performance in August 1982, all the four groups show improvement in their performance in 2nd, 3rd and 4th period of testing, but the average performances seen to have gone down in all the four groups when it was recorded in April 1983. Groupwise performance in Zig Zag Run during different seasons of the year is shown in the Table-26.

TABLE-26

Zig Zag Run : Average Performance to Each Rutu

S. No.	Rutu and date	Groups				Remarks
		B	C_1	C_2	C_3	
		Time in Seconds				
1.	Varsha-Shared	26.64	26.13	24.65	26.69	Initial Performance
2.	Sharad-Hemant	24.57	25.52	23.09	26.16	Increase in Performance
3.	Hemant-Shishir	25.06	25.05	22.72	25.56	Increase in Performance
4.	Shishir-Vasant	22.78	24.66	22.48	25.00	Maximum Performance
5.	Vasant-Rutu	23.46	25.28	24.22	25.51	Decrease in Performance

2. Medicine Ball Put : A periodical performance of Group A in medicine ball put clearly shows an ascending trend during the first seven periods of testing. The performance that reached to maximum during the seventh period, started receding during the last two periods of Vasant and Grishma Rutu respectively. The Table-27 gives information about the average performance in each Rutu along with the figures of minimum and maximum performance and range as well as well standard deviation of all these scores.

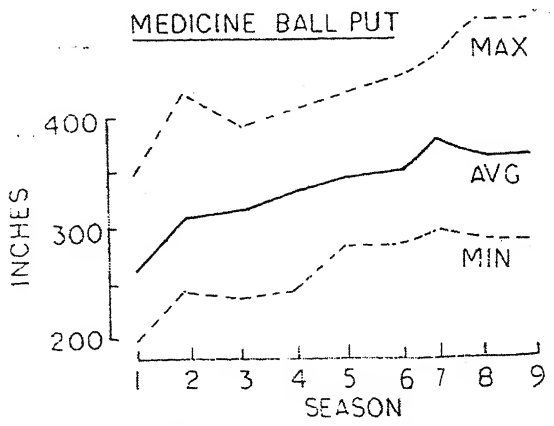
TABLE-27

Medicine Ball Put : Average Performance in each Rutu.

S. No.	Rutu and Date	Distance in Inches Min	Max	Avg	Range	Std. Dev.
1.	Shishir-Rutu	196	344	259.64	148	45.83
2.	Vasant-Grishma	240	422	307.35	182	58.49
3.	Grishma-Varsha	237	391	316.11	154	41.00
4.	Varsha-Shared	241	405	330.05	164	50.13
5.	Sharad-Hemant	277	416	341.29	139	47.77
6.	Hemant-Shishir	281	432	345.00	151	44.00
7.	Shishir-Vasant	293	451	373.76	158	48.54
8.	Vasant-Rutu	283	482	360.05	199	52.72
9.	Grishma	277	480	358.53	203	52.98

The average medicine ball put score was 307.35 inches in Grishma Rutu which shot upto 373.76 in Shishir-Vasant. The individual scores fluctuated from 196 to 482 in Shishir-Vasant after one year of experimentation. The average score dropped to 358.53 at the commencement of Grishma Rutu.

A graphical representation ofthe periodical performance of Group A in the event during difference seasons of the year is shown in figure.



Periodical Performance ofGroup A

Observations pertaining to the periodical performance of the remaining four groups vis. B, C_1, C_2, C_3 in this event reveal that the performance improves through 2nd, 3rd and 4th periods respectively, but during the 5th period of performance goes down in all the four groups. This last period marks the onset of summer. Decrease in performance coincides with the onset of Grishma. As long as the winter season was progressing, the performance also kept on increasing. These observations can be made from the Table-28.

TABLE-28

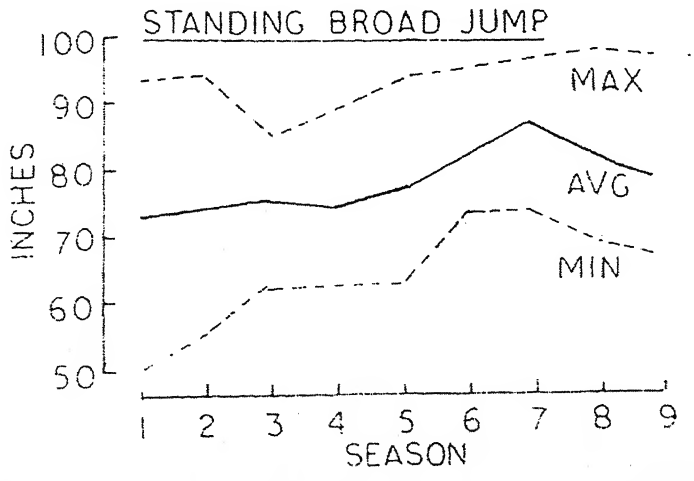
Medicine Ball Put : Average Performance in each Rutu.

S. NO.	Rutu and date	Groups B	C_1	C_2	Remarks C_3
			Distance in Inches		
1.	Varsha-Shared	270.15	323.61	284.48	242.12
2.	Sharad-Hemant	286.19	332.72	301.81	240.60
3.	Hemant-Shishir	311.38	353.38	308.14	251.18
4.	Shishir-Vasant	329.04	359.22	318.44	255.12
5.	Vasant-Rutu	319.33	352.05	313.48	250.68

3. Standing Broad Jump : The event of standing broad jump was conducted and performance of group "A" recorded for nine times. The Table-29 gives details of the performances that were recorded periodically.

S. No.	Rutu and Date	Length in Inches				
		Min	Max	Avg	Range	Std. Dev.
1.	Shishir-Rutu	50	93	73.58	43	10.40
2.	Vasant-Grishma	55	94	74.64	39	9.11
3.	Grishma-Varsha	62	85	75.76	23	6.77
4.	Varsha-Shared	62	89	74.58	27	6.48
5.	Sharad-Hemant	62	93	76.82	31	6.76
6.	Hemant-Shishir	73	94	81.05	21	6.29
7.	Shishir-Vasant	73	96	87.23	23	6.42
8.	Vasant-Rutu	69	97	81.41	28	8.14
9.	Grishma	66	96	78.05	30	7.11

A careful study of the Table-29 reveals that there is a gradual increase in performance during 2nd and 3rd period of testing. The performance goes down slightly during 4th period i.e. in August, but then keeps on improving during 5th, 6th and 7th periods, which fall under winter season. After achieving maximum level in 7th period i.e. in February, the group performance goes down during the last two periods of testing, which fall under the summer season. A graph depicting maximum, minimum and average level of performance is presented in figure.



Standing Broad Jump : Seasonal Level of

Performance for Group A.

The performance of the remaining four groups in standing broad jump was recorded like other events for 5 times during the year.

The starting performance was taken in August 1982 and with the interval of two months, the last i.e. fifth one was recorded in the month of April. The Table-30 shows the average performance of all these groups in different seasons.

TABLE-30
Standing Broad Jump : Average Performance of Remaining Four Groups during Different Seasons.

S.NO.	Rutu and date	Length in Inches				Remarks
		B	C_1	C_2	C_3	
1.	Varsha-Shared	69.76	74.83	69.62	66.84	Initial Performance
2.	Sharad-Hemant	73.14	77.11	76.96	69.56	Increase in Performance
3.	Hemant-Shishir	76.28	81.22	70.63	72.31	Increase in Performance
4.	Shishir-Vasant	81.90	84.38	84.25	75.06	Maximum Performance
5.	Vasant-Rutu	78.85	81.38	78.48	71.76	Decrease in Performance

STATISTICAL ANALYSIS OF VARIANCE

The foregoing in paragraphs have broadly indicated that in case of group A the initial performance recorded in February 1982

showed slight deterioration in next two tests conducted in Grishma and Varsha Rutu respectively. The performance improved gradually till the next February. It reached maximum in all the events in the same month and again went on falling in next Vasant and Grishma seasons. Thus, the performance of group A shows tendency to rise or fall coinciding with the rise and fall of air temperature as shown in figure.

The remaining four groups were tested periodically is all the four events of track and field and three motor ability factors simultaneously, starting from August 1982 to April. Here also it is observed that the performance in all the seven events show a common tendency to rise upto first four tests. The fourth test was conducted in Shishir-Vasant Rutu i.e. the month of February. And them there is a fall in the performance of the last test conducted in Vasant-Grishma Rutu i.e. April. This tendency of rise and fall in the performance of this four groups also coincides with the rise and fall in the air temperature.

In order to examine this features in the trend of the performance dates, rigorous test of statistical analysis of variance was applied to the scores of the students. The variance in the individual scores are due to two factors namely :

1. Variations from student to student
2. Variations from season to season or between Rutus.

The analysis of variance test isolates these two variations separately from the total variation leaving the balance variation known as the error variation, which is not attributed to any cause. This error variation is the random variation free from the known factors, the periods and the students' comparison of the mean variance of the known factors with the error variance gives the F-statistics, the significance of which is tested at 5% level from F-distribution.

GROUP-A

TABLE-31

Analysis of Variance for the Performance in Athletic Events

1. 100 METERS RUN

Source	Sum of squares	D.F.	Mean square	F	5%	Significance
Rutus	421.7664	8	52.7208	117.79	2.00	Highly Signi.
Students	74.0532	16	4.6283	10.34	1.70	Highly Signi.
Error	57.2892	128	0.4476			
Total	553.1088	152				

1. SHOT PUT

Source	Sum of squares	D.F.	Mean square	F	5%	Signi.
Rutus	60388.5228	8	75.48.5653	19.16	2.00	Highly Signi.
Students	177943.5032	16	11121.4689	28.23	1.70	Highly Signi.
Error	50426.1439	128	393.9542			
Total	288758.1699	152				

3. HIGH JUMP

Source	Sum of squares	D.F.	Mean square	F	5%	Signi.
Rutus	2955.1896	8	369.3987	42.07	2.00	Highly Signi.
Students	2817.3595	16	176.0850	20.06	1.70	Highly Signi.
Error	1123.6993	128	8.7786			
Total	6896.2484	152				

4. LONG JUMP

Source squares	Sum of	D.F. square	Mean	F	5%	Signi.
Rutus	21056.9934	8	2632.1242	26.91	2.00	Highly Signi.
Students	22678.1699	16	1417.3856	14.49	1.70	Highly Signi.
Error	12519.0067	128	97.8047			
Total	56254.1600	152				

GROUP-B

TABLE-32

Analysis of Variance for the Performance in Athletic Events

1. 100 METERS RUN

Source squares	Sum of	D.F. square	Mean	F	5%	Signi.
Rutus	26.1891	4	6.5473	44.78	2.50	Highly Signi.
Students	67.2556	20	3.3618	22.99	1.75	Highly Signi.
Error	11.6949	80	0.1462			
Total	105.1196	104				

2. SHOT PUT

Source squares	Sum of	D.F. square	Mean	F	5%	Signi.
Rutus	122472.5600	4	50618.1400	71.75	2.50	Highly Signi.
Students	275996.2000	20	13799.8100	32.34	1.75	Highly Signi.
Error	34141.0400	80	426.7600			
Total	432609.8000	104				

3. HIGH JUMP

Source squares	Sum of	D.F. square	Mean	F	5%	Signi.
Rutus	592.5400	4	148.1330	33.26	2.50	Highly Signi.
Students	1829.4500	20	91.4725	20.54	1.75	Highly Signi.
Error	356.2600	80	4.4533			
Total	2778.2500	104				

4. LONG JUMP

Source squares	Sum of	D.F. square	Mean	F	5%	Signi.
Rutus	6452.8200	4	1613.2050	16.23	2.50	Highly Signi.
Students	37247.7300	20	1862.3865	18.73	1.75	Highly Signi.
Error	7955.9800	80	99.4248			
Total	51654.550	104				

GROUP C_1

TABLE-33

Analysis of Variance for the Performance in Athletic Events

1. 100 METERS RUN

Source squares	Sum of	D.F. square	Mean	F	5%	Signi.
Rutus	4.4640	4	1.1160	18.54	2.52	Highly Signi.
Students	53.2560	17	1.9562	32.50	1.35	Highly Signi.
Error	4.0960	68	0.0602			
Total	41.8160	89				

2. SHOT PUT

Source squares	Sum of	D.F. square	Mean	F	5%	Signi.
Rutus	2892.1500	4	723.0375	29.36	2.52	Highly Signi.
Students	261319.3000	17	15371.7230	624.18	1.35	Highly Signi.
Error	1674.6500	68	24.6272			
Total	265856.1000	89				

3. HIGH JUMP

Source squares	Sum of	D.F. square	Mean	F	5%	Signi.
Rutus	174.7800	4	43.6950	2063	2.52	Highly Signi.
Students	2541.9300	17	149.5253	70.60	1.35	Highly Signi.
Error	144.0200	68	2.1179			
Total	2860.7300	89				

4. HIGH JUMP

Source squares	Sum of	D.F. square	Mean	F	5%	Signi.
Rutus	2036.1000	4	509.0250	9.67	2.52	Highly Signi.
Students	27877.6000	17	1639.8988	31.15	1.35	Highly Signi.
Error	3580.1000	68	52.6485			
Total	33493.8000	89				

GROUP C_2

TABLE-34

Analysis of Variance for the Performance in Athletic Events

1. 100 METERS RUN

Source	Sum of squares	D.F.	Mean square	F	5%	Signi.
Rutus	88.6020	4	22.1505	70.34	2.47	Highly Signi.
Students	122.2460	26	4.7018	15.25	1.64	Highly Signi.
Error	32.7466	104	0.3149			
Total	243.5946	134				

2. SHOT PUT

Source	Sum of squares	D.F.	Mean square	F	5%	Signi.
Rutus	116672.2000	4	29168.0500	84.53	2.47	Highly Signi.
Students	282243.3000	26	10855.5100	417.52	1.64	Highly Signi.
Error	35761.4000	104	343.8596			
Total	434676.9000	134				

3. HIGH JUMP

Source	Sum of squares	D.F.	Mean square	F	5%	Signi.
Rutus	331.3100	4	82.8275	17.12	2.47	Highly Signi.
Students	1514.5400	26	58.2515	12.04	1.64	Highly Signi.
Error	503.0900	104	4.8374			
Total	2348.9400	134				

4. LONG JUMP

Source squares	Sum of	D.F. square	Mean	F	5%	Signi.
Rutus	3987.1000	4	996.7750	9.35	2.47	Highly Signi.
Students	32749.2000	26	1259.5846	11.81	1.64	Highly Signi.
Error	11091.3000	104	106.6471			
Total	47827.6000	134				

GROUP C_3

TABLE-35

Analysis of Variance for the Performance in Athletic Events

1. 100 METERS RUN

Source squares	Sum of	D.F. square	Mean	F	5%	Signi.
Rutus	3.7763	4	0.9441	30.16	2.52	Highly Signi.
Students	83.8080	15	5.5872	118.50	1.80	Highly Signi.
Error	1.8757	60	0.0313			
Total	89.4600	79				

2. SHOT PUT

Source squares	Sum of	D.F. square	Mean	F	5%	Signi.
Rutus	1759.9400	4	439.9900	2.55	2.52	Highly Signi.
Students	70961.8000	15	4730.7900	27.40	1.80	Highly Signi.
Error	10359.2600	60	172.6500			
Total	83081.0000	79				

3. HIGH JUMP

Source	Sum of squares	D.F.	Mean square	F	5%	Signi.
Rutus	154.0100	4	56.5000	15.98	2.52	Highly Signi.
Students	1595.8000	15	106.2500	44.09	1.80	Highly Signi.
Error	144.3900	60	2.4100			
Total	1892.2000	79				

4. LONG JUMP

Source	Sum of squares	D.F.	Mean square	F	5%	Signi.
Rutus	3977.5775	4	994.5944	63.85	2.52	Highly Signi.
Students	19086.8875	15	1272.4597	81.71	1.80	Highly Signi.
Error	954.4225	60	15.5737			
Total	25998.8875	79				

GROUP-A

TABLE-36

Analysis of Variance for Motor Ability Factors

1. MEDICINE BALL PUT

Source	Sum of squares	D.F.	Mean square	F	5%	Signi.
Rutus	162989.1503	8	20373.6438	45.50	2.02	Highly Signi.
Students	304647.3856	16	19040.4616	42.53	1.70	Highly Signi.
Error	57308.8437	128	447.7254			
Total	524945.3856	152				

2. ZIG-ZAG RUN

Source	Sum of squares	D.F.	Mean square	F	5%	Signi.
Rutus	823.7847	8	102.9731	102.49	2.02	Highly Signi.
Students	106.3062	16	6.6441	6.13	1.70	Highly Signi.
Error	128.5997	128	1.0047			
Total	1058.6906	152				

3. STANDING BROAD JUMP

Source	Sum of squares	D.F.	Mean square	F	5%	Signi.
Rutus	2632.6797	8	329.0849	10.03	2.02	Highly Signi.
Students	4762.9412	16	297.6858	9.07	1.70	Highly Signi.
Error	4201.7647	128	32.8263			
Total	11597.3856	152				

GROUP-B

TABLE-37

Analysis of Variance for Motor Ability Factors

1. MEDICINE BALL PUT

Source	Sum of squares	D.F.	Mean square	F	5%	Signi.
Rutus	53066.9300	4	13266.76300	11.92	2.50	Highly Signi.
Students	379957.0300	20	18997.8515	11.07	1.78	Highly Signi.
Error	89006.5307	80	1112.5816			
Total	469494.2300	107				

2. ZIG-ZAG RUN

Source	Sum of squares	D.F.	Mean square	F	5%	Signi.
Rutus	207.8400	4	51.9600	118.41	2.50	Highly Signi.
Students	109.7000	20	5.4850	12.50	1.78	Highly Signi.
Error	35.1000	80	0.4388			
Total	352.6400	104				

3. STANDING BROAD JUMP

Source	Sum of squares	D.F.	Mean square	F	5%	Signi.
Rutus	1893.9400	4	473.4850	32.99	2.50	Highly Signi.
Students	9744.9900	20	487.2435	33.95	1.78	Highly Signi.
Error	1148.0600	80	14.3508			
Total	12786.9900	104				

GROUP C_1

TABLE-38

Analysis of Variance for Motor Ability Factors

1. MEDICINE BALL PUT

Source	Sum of squares	D.F.	Mean square	F	5%	Signi.
Rutus	16694.7800	4	4173.6950	22.18	2.52	Highly Signi.
Students	265632.0000	17	15625.4110	83.02	1.35	Highly Signi.
Error	12798.220	68	188.2091			
Total	295125.0000	89				

2. ZIG-ZAG RUN

Source	Sum of squares	D.F.	Mean square	F	5%	Signi.
Rutus	21.8390	4	5.4598	77.89	2.52	Highly Signi.
Students	43.0160	17	2.5303	36.10	1.35	Highly Signi.
Error	4.7690	68	0.0701			
Total	69.6240	89				

3. STANDING BROAD JUMP

Source	Sum of squares	D.F.	Mean square	F	5%	Signi.
Rutus	1035.0400	4	258.7600	36.63	2.52	Highly Signi.
Students	4745.5900	17	279.1524	39.51	1.35	Highly Signi.
Error	480.3600	68	7.0641			
Total	6260.9900	89				

GROUP C_2

TABLE-39

Analysis of Variance for Motor Ability Factors

1. MEDICINE BALL PUT

Source	Sum of squares	D.F.	Mean square	F	5%	Signi.
Rutus	18722.0000	4	4680.5000	7.27	2.47	Highly Signi.
Students	247287.0000	26	9511.0404	14.77	1.64	Highly Signi.
Error	66969.0000	104	643.9327			
Total	332978.0000	134				

2. ZIG-ZAG RUN

Source	Sum of squares	D.F.	Mean square	F	5%	Signi.
Rutus	97.7890	4	24.4472	81.03	2.47	Highly Signi.
Students	31.1330	26	1.1974	3.97	1.64	Highly Signi.
Error	31.5710	104	0.3017			
Total	160.2930	134				

2. ZIG-ZAG RUN

Source	Sum of squares	D.F.	Mean square	F	5%	Signi.
Rutus	97.7890	4	24.4472	81.03	2.47	Highly Signi.
Students	31.1330	26	1.1974	3.97	1.64	Highly Signi.
Error	31.5710	104	0.3017			
Total	160.2330	134				

3. STANDING BROAD JUMP

Source	Sum of squares	D.F.	Mean square	F	5%	Signi.
Rutus	3171.5100	4	792.8774	38.70	2.47	Highly Signi.
Students	9296.6000	26	357.5615	17.45	1.64	Highly Signi.
Error	2130.8900	104	20.4892			
Total	14599.0000	134				

Minimum, Maximum, and Average for performance of athletic events and motor ability factors and air temperature for group-A

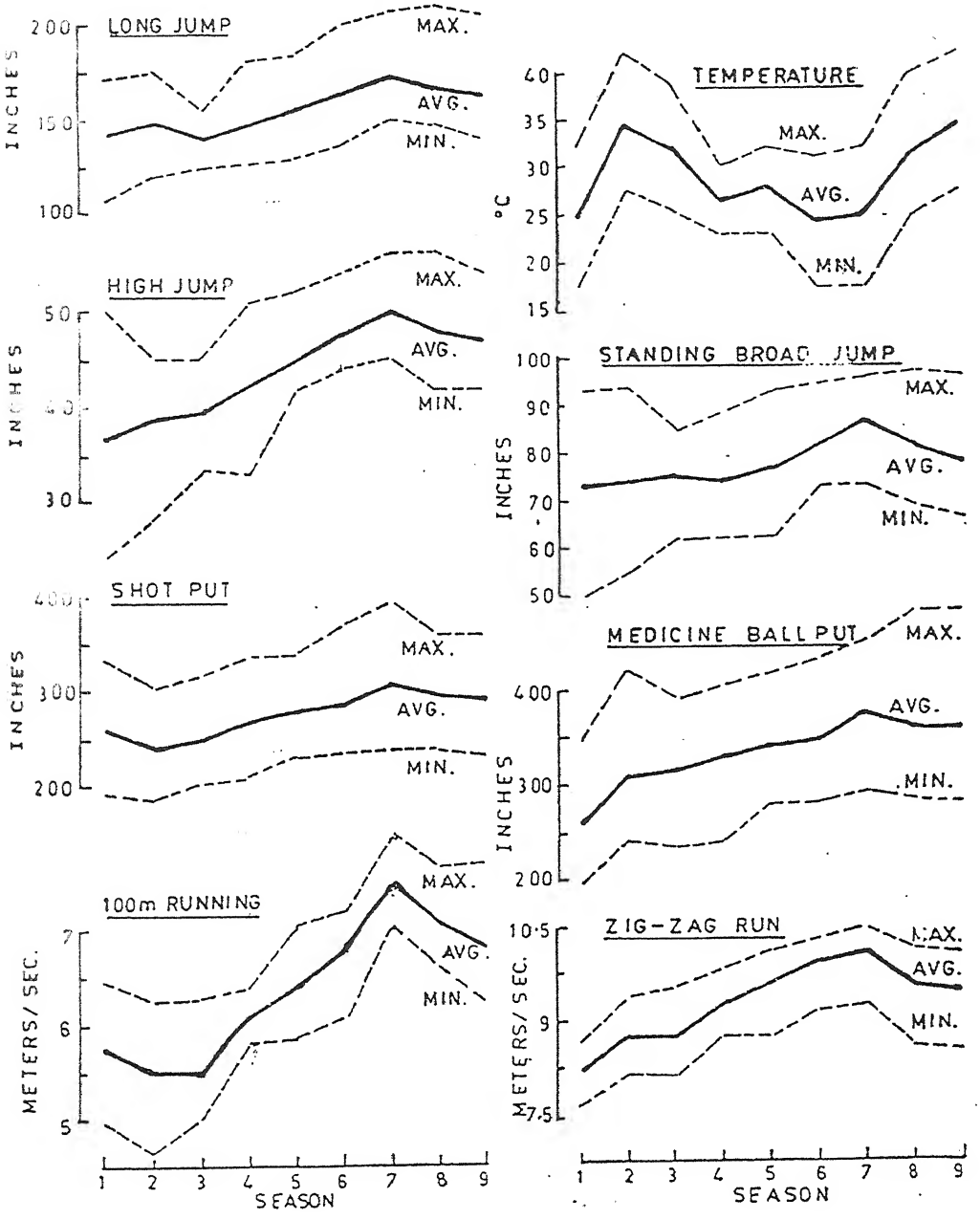


TABLE-40
Indices of Performance for Athletic Events for various Groups in different Rutus

1. GROUP-B

Rutu	Date	100 m Running	Shot Put	Long Jump	High Jump	Overall Index
Versha-Sharad	10.08.82	94.62	79.80	90.76	91.41	89.14
Sharad-Hemant	20.10.82	99.46	90.09	97.32	95.45	95.58
Vasant-Shishir	20.12.82	102.53	106.65	102.18	102.95	103.57
Shishir-Vasant	20.02.83	104.32	108.55	106.54	107.32	106.66
Hemant-Rutu	20.04.83	99.60	114.90	103.18	102.95	105.15

2. GROUP-C_1

Rutu	Date	100 m Running	Shot Put	Long Jump	High Jump	Overall Index
Versha-Sharad	01.08.80	97.97	96.67	95.07	94.45	96.04
Sharad-Hemant	20.10.82	99.45	98.97	98.30	98.40	98.78
Vasant-Shishir	20.12.82	101.11	101.10	101.00	101.85	101.26
Shishir-Vasant	20.02.83	102.32	103.08	104.41	104.09	103.47
Hemant-Rutu	20.04.83	99.11	100.22	101.18	101.18	100.42

3. GROUP-C_2

Rutu	Date	100 m Running	Shot Put	Long Jump	High Jump	Overall Index
Versha-Sharad	01.08.82	91.64	85.72	93.39	94.82	91.44
Sharad-Hemant	20.10.82	101.67	94.14	100.25	98.47	98.63
Vasant-Shishir	20.12.82	103.80	105.77	101.36	101.38	103.08
Shishir-Vasant	20.02.83	105.00	109.70	104.72	104.14	105.89
Hemant-Rutu	20.04.83	99.03	104.64	100.27	101.22	101.29

4. GROUP-C_3

Rutu	Date	100 m Running	Shot Put	Long Jump	High Jump	Overall Index
Versha-Sharad	01.08.82	98.10	96.48	91.59	95.06	95.30
Sharad-Hemant	20.10.82	99.19	100.53	95.95	98.21	98.47
Vasant-Shishir	20.12.82	100.94	102.11	100.76	101.07	101.22
Shishir-Vasant	20.02.83	102.03	97.81	106.32	104.33	102.62
Hemant-Rutu	20.04.83	99.69	103.07	105.37	101.34	102.36

TABLE-41

Indices of Motor Ability Factors for Various Groups in different Rutus

1. GROUP-B

Rutu	Date	Medicine Ball Put	Zig-Zag Run	Standing Broad Jump	Overall Index
Versha-Sharad	01.08.82	89.15	90.46	91.81	90.37
Sharad-Hemant	20.10.82	94.44	98.01	96.26	96323
Hemant-Shishir	20.12.82	102.75	104.51	100.39	102.55
Shishir-Vasant	20.02.83	108.58	105.79	107.79	107.38
Vasant-Rutu	20.04.83	105.05	102.73	103.77	103.85

2. GROUP-C_1

Rutu	Date	Medicine Ball Put	Zig-Zag Run	Standing Broad Jump	Overall Index
Versha-Sharad	01.08.82	94.02	96.90	93.79	94.90
Sharad-Hemant	20.10.82	96.66	99.22	96.65	97.51
Hemant-Shishir	20.12.82	102.67	101.08	101.80	101.85
Shishir-Vasant	20.02.83	104.36	102.67	105.76	104.26
Vasant-Rutu	20.04.83	102.28	100.16	102.00	101.48

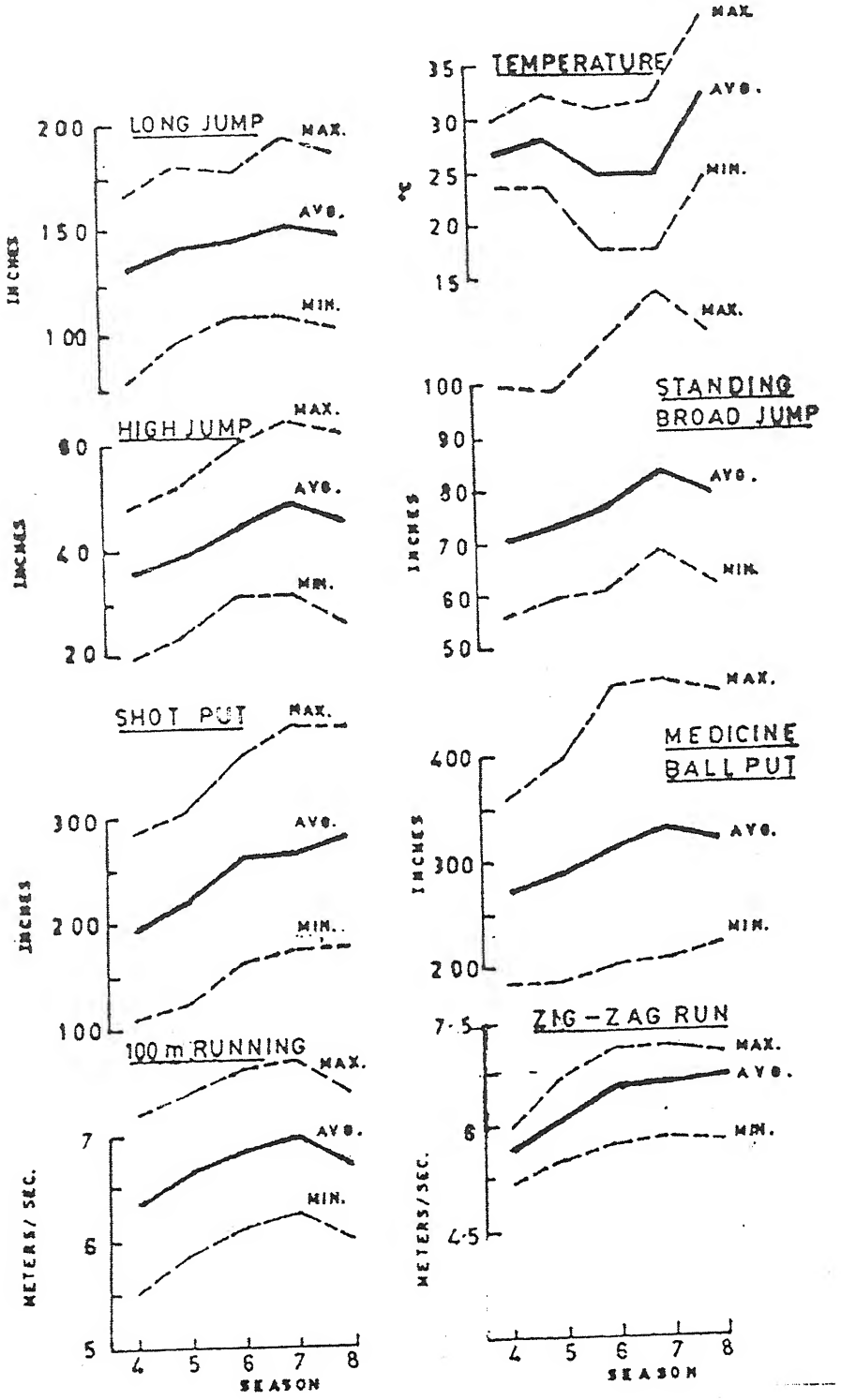
3. GROUP-C_2

Rutu	Date	Medicine Ball Put	Zig-Zag Run	Standing Broad Jump	Overall Index
Versha-Sharad	01.08.82	93.18	95.05	89.28	92.50
Sharad-Hemant	20.10.82	98.86	101.47	98.69	99.67
Hemant-Shishir	20.12.82	100.94	103.13	103.39	102.48
Shishir-Vasant	20.02.83	104.31	104.23	108.04	105.52
Vasant-Rutu	20.04.83	102.68	96.73	100.64	100.01

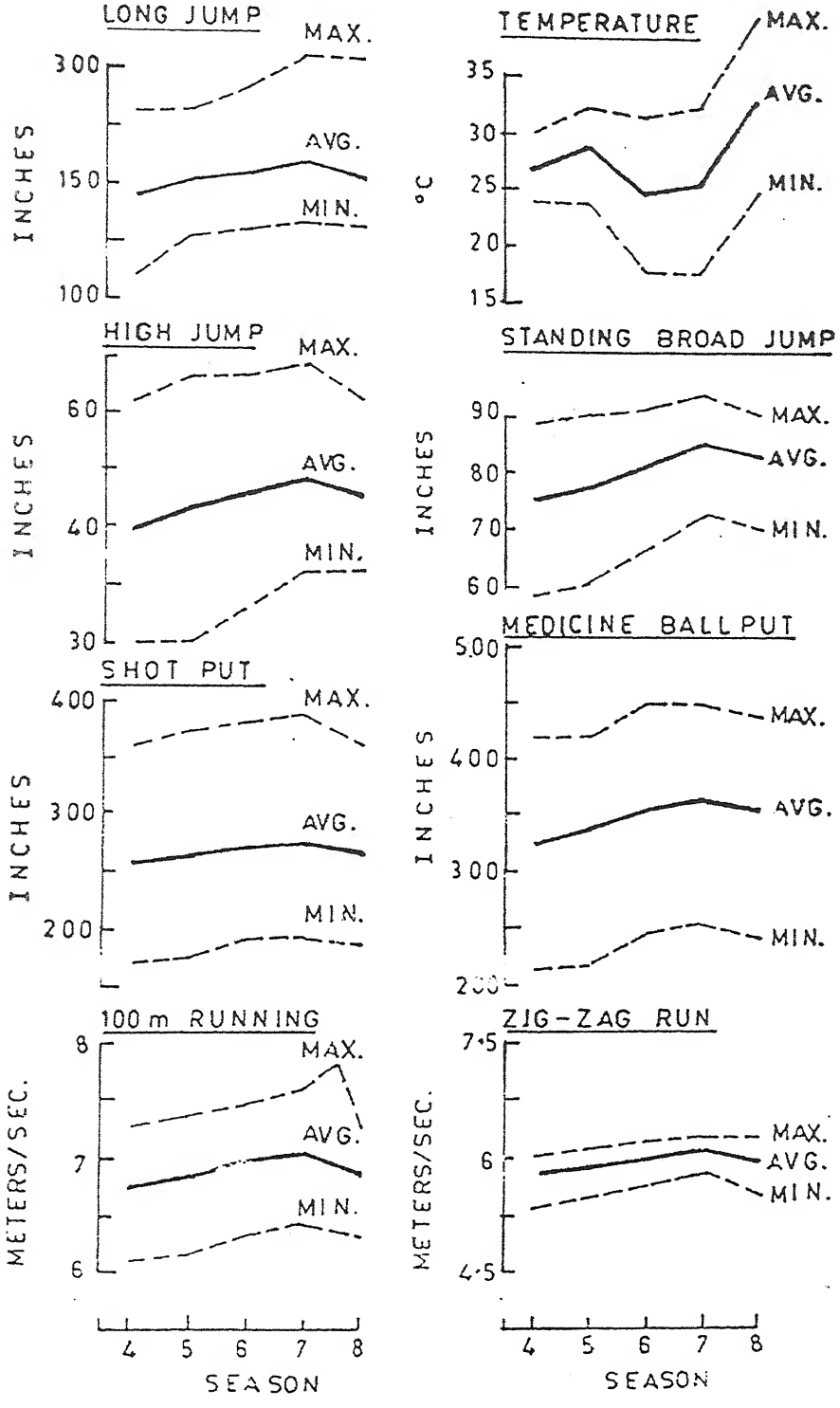
4. GROUP-C_3

Rutu	Date	Medicine Ball Put	Zig-Zag Run	Standing Broad Jump	Overall Index
Versha-Sharad	01.08.82	97.65	101.39	94.00	97.68
Sharad-Hemant	20.10.82	97.04	97.32	97.83	97.39
Hemant-Shishir	20.12.82	101.30	99.61	101.70	100.87
Shishir-Vasant	20.02.83	102.89	101.84	105.56	103.43
Vasant-Rutu	20.04.83	101.10	99.80	10.92	100.60

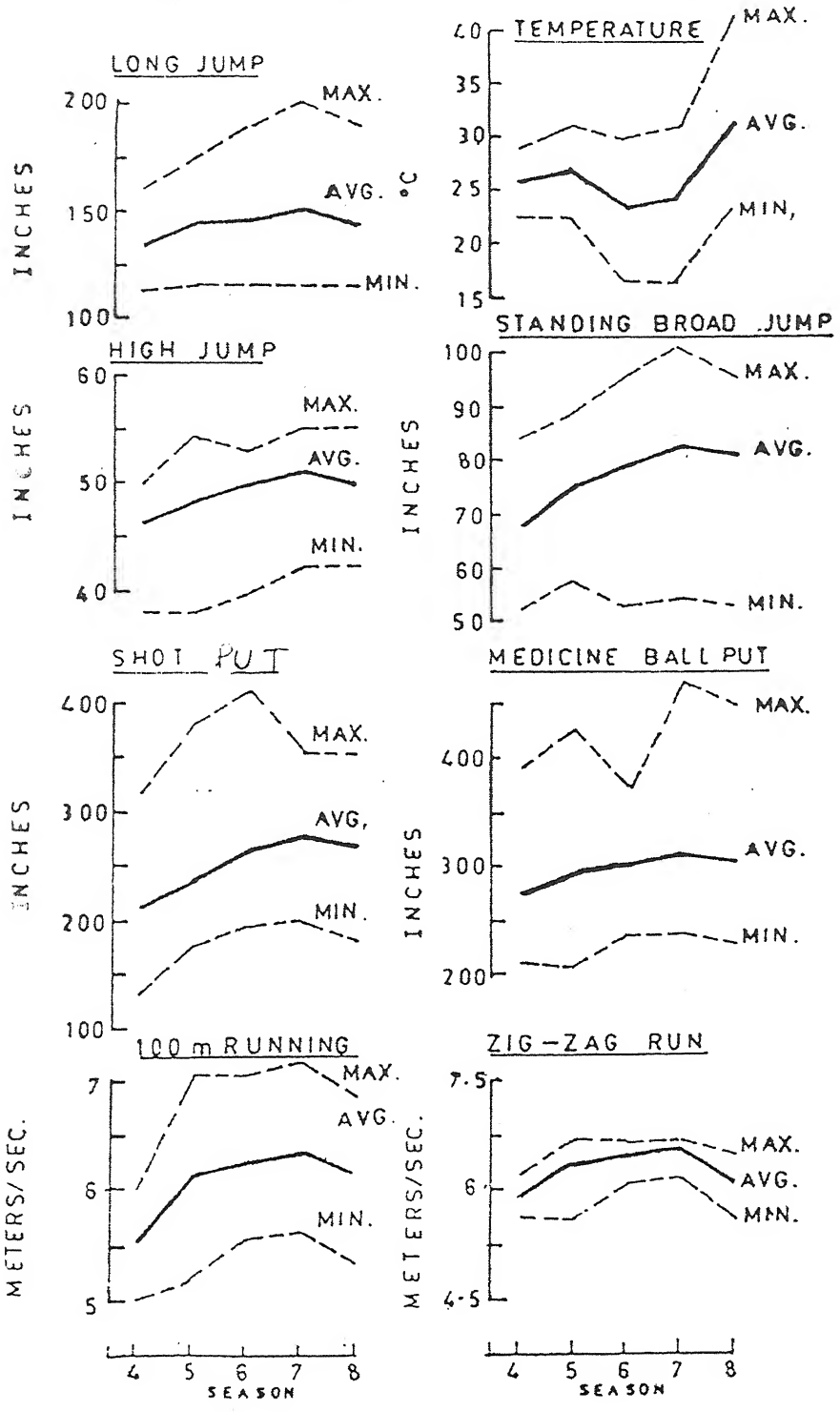
Performance of Athletic Events and Motor Ability Factors Along with Air Temperature for Group-B



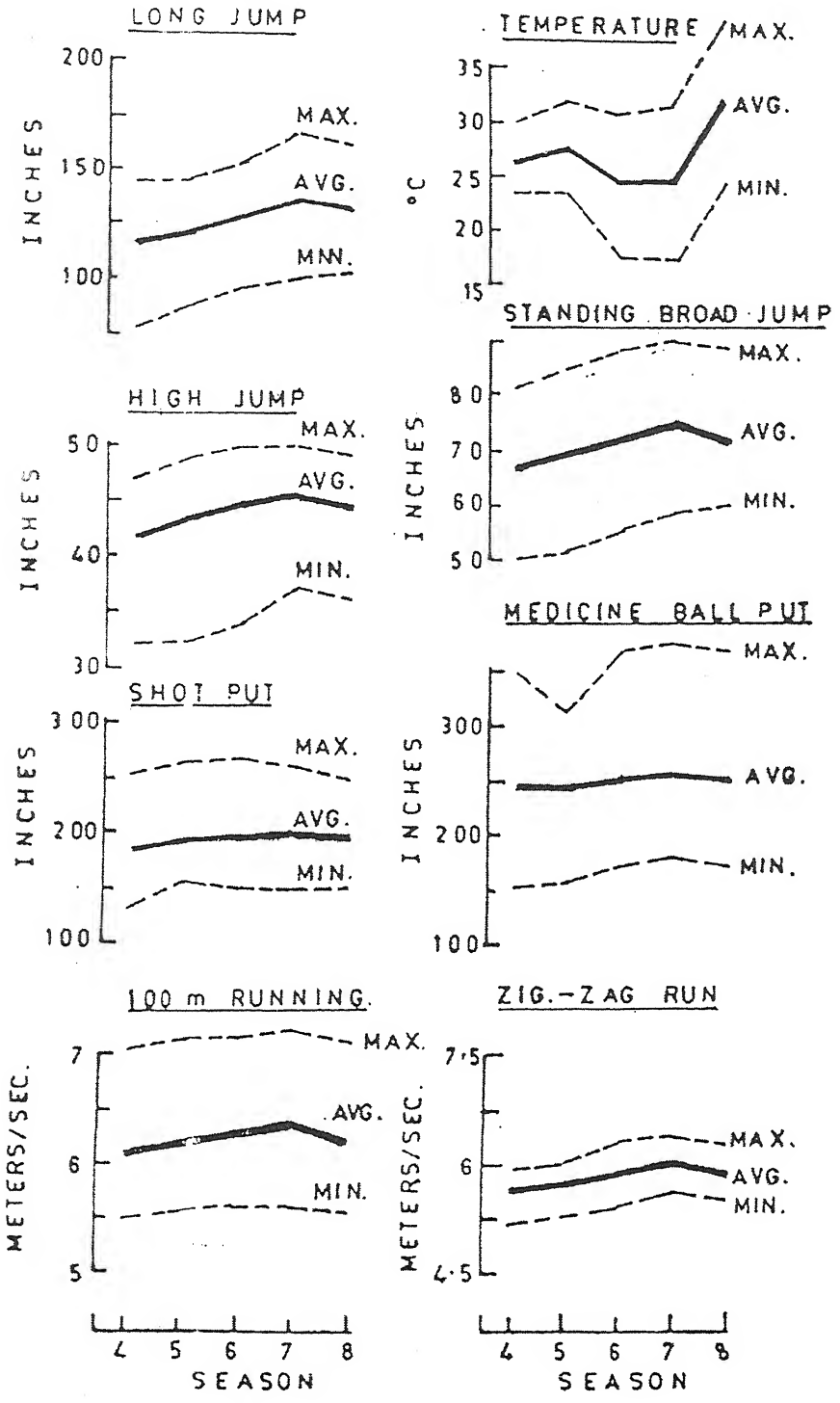
Performance of Athletic Events and Motor Ability Factors Along with Air Temperature for Group-C_1



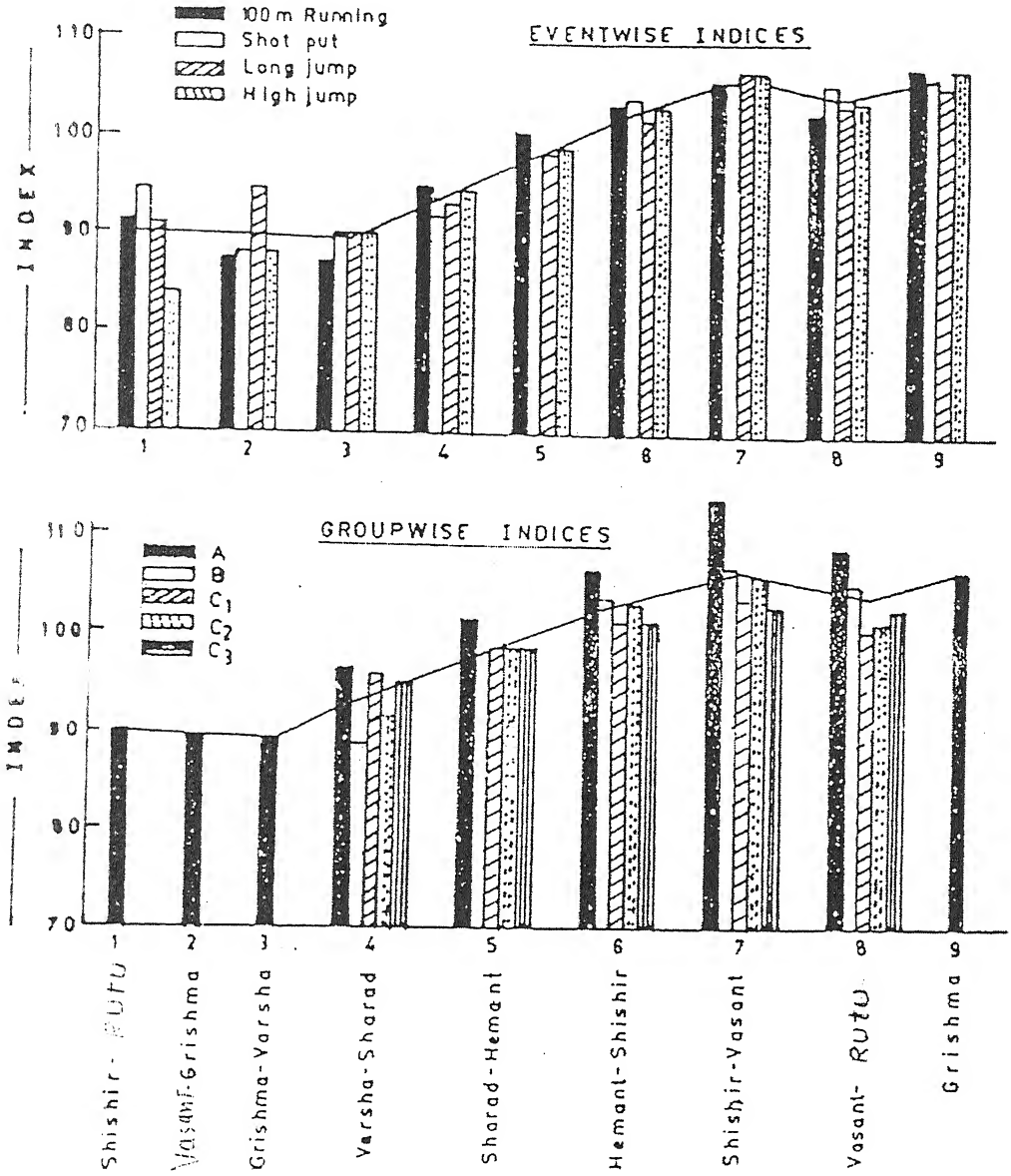
Performance of Athletic Events and Motor Ability Factors Along with Air Temperature for Group-C_2



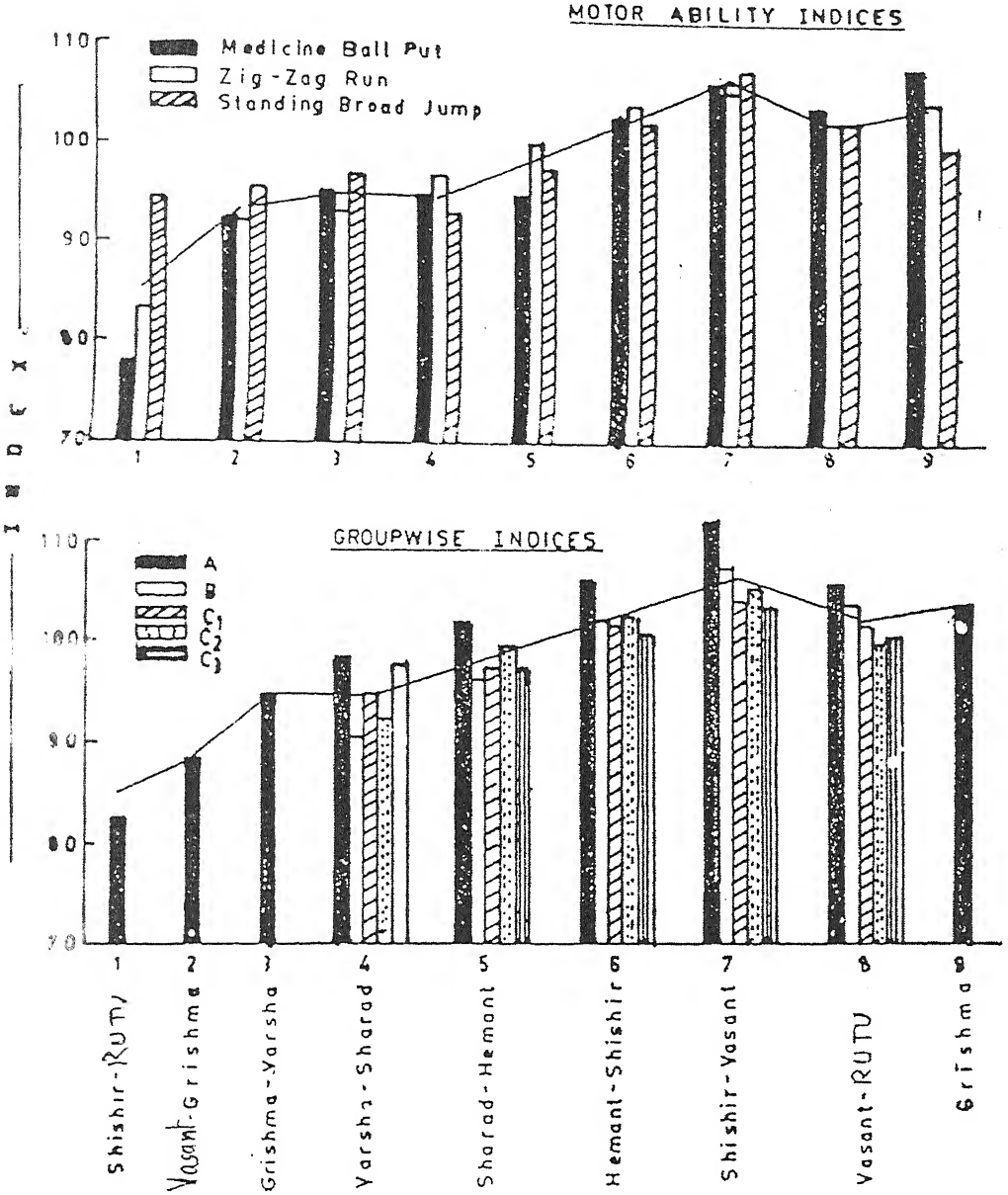
Performance of Athletic Events and Motor Ability Factors Along with Air Temperature for Group-C_3



Groupwise and Eventwise Indices of Performance Athletic Events in Different Rutus



Groupwise and Factories Indices of Motor Ability Factors in Different Rutus



Indices of Performance in Athletic Events and Motor Ability Factors According to Different Rutus

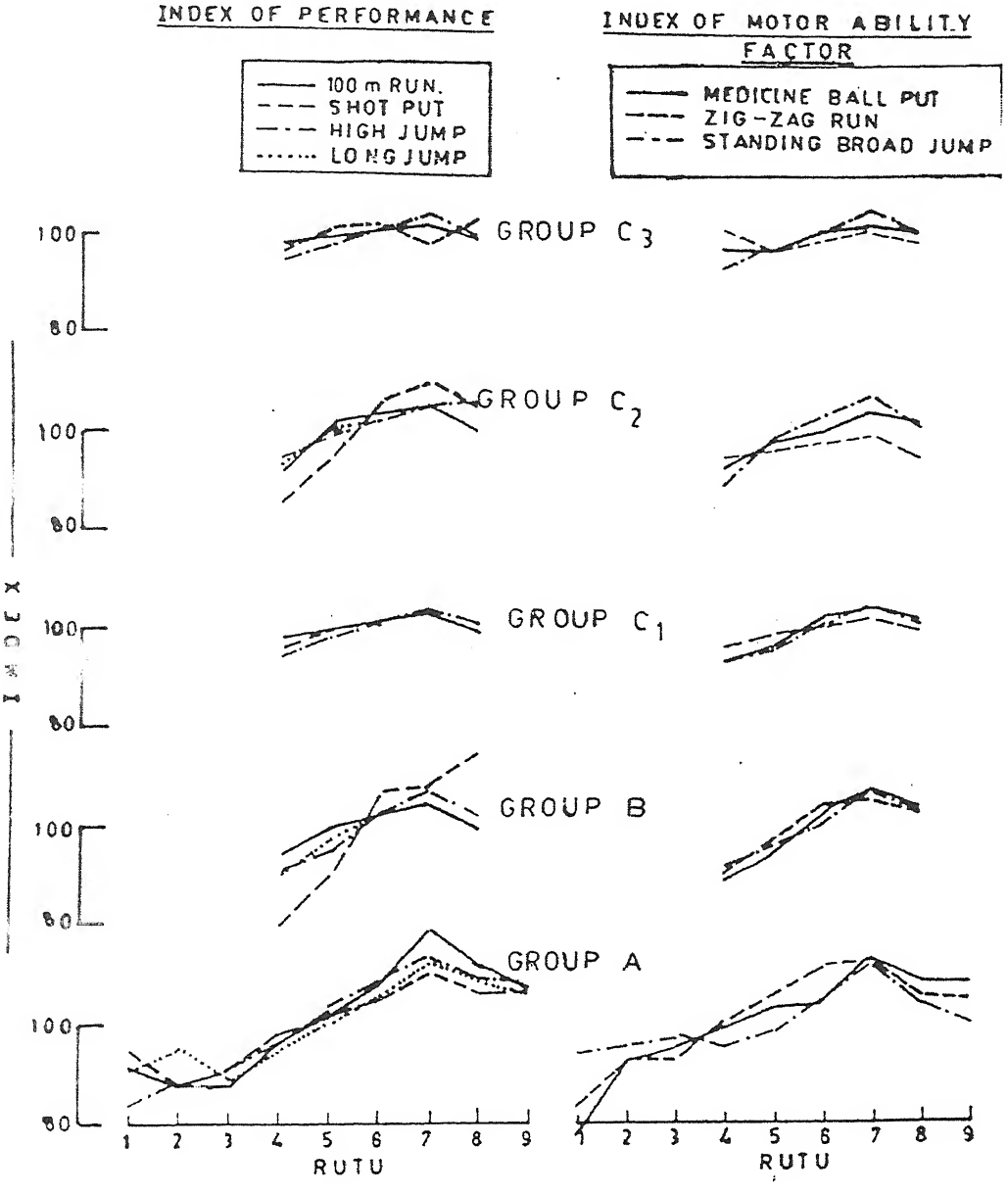


TABLE-42
Indices of Performance of Athletic Events for Different Rutus

GROUPWISE

Rutu	Date	Index for the Group					Overall
		A	B	C_1	C_2	C_3	Index
Shishir-Rutu	15.02.82	90.28					90.28
Vasant-Grishma	07.05.82	89.50					89.50
Grishma-Varsha	20.06.82	89.25					89.25
Varsha-Sharad	20.08.82	96.55	89.14	96.04	91.44	95330	93.69
Sharad-Hemant	20.10.82	101.38	95.58	98.78	98.63	98.47	98.57
Hemant-Shishir	20.12.82	106.33	103.57	101.26	103.08	101.22	103.09
Shishir-Vasant	20.02.83	113.78	106.68	103.47	105.89	102.62	106.49
Vasant-Rutu	20.04.83	108.85	105.15	100.42	101.29	102.36	103.61
Grishma-Rutu	20.05.83	106.55					106.55

TABLE-43
Indices of Performance of Athletic Events for Different Rutus

EVENTWISE

Rutu	Date	Index for the Events				Overall
		100 m Running	Shot Put	Long Jump	High Jump	Index
Shishir-Rutu	15.02.82	91.50	94.50	91.10	84.00	90.28
Vasant-Grishma	07.05.82	87.40	87.90	94.80	87.90	89.50
Grishma-Varsha	20.06.82	87.20	90.80	88.90	90.10	89.25

Varsha-Sharad	20.08.82	95.44	91.75	93.18	94.44	93.70
Sharad-Hemant	20.10.82	100.52	97.03	98.36	98.70	98.65
Hemant-Shishir	20.12.82	103.41	104.00	102.08	103.11	103.15
Shishir-Vasant	20.02.83	105.69	105.88	106.84	106.69	106.28
Vasant-Rutu	20.04.83	102.50	105.84	103.58	103.22	103.78
Grishma-Rutu	20.05.83	107.50	106.20	105.30	107.20	106.55

TABLE-44

Indices of Motor Ability Factors for different Rutus

GROUPWISE

Rutu	Date	Index for the Group					Overall
		A	B	C_1	C_2	C_3	Index
Shishir-Rutu	15.02.82	85.20					85.20
Vasant-Grishma	07.05.82	93.45					93.45
Grishma-Varsha	20.06.82	94.93					94.93
Varsha-Sharad	20.08.82	98.46	90.37	94.90	92.50	97.68	94.78
Sharad-Hemant	20.10.82	102.12	96.23	97.51	99.67	97.39	98.52
Hemant-Shishir	20.12.82	106.28	102.55	101.85	102.48	100.87	102.81
Shishir-Vasant	20.02.83	112.28	107.38	104.26	105.52	103.43	106.55
Vasant-Rutu	20.04.83	105.92	103.85	101.48	100.01	100.30	102.37
Grishma-Rutu	20.05.83	104.06					104.06

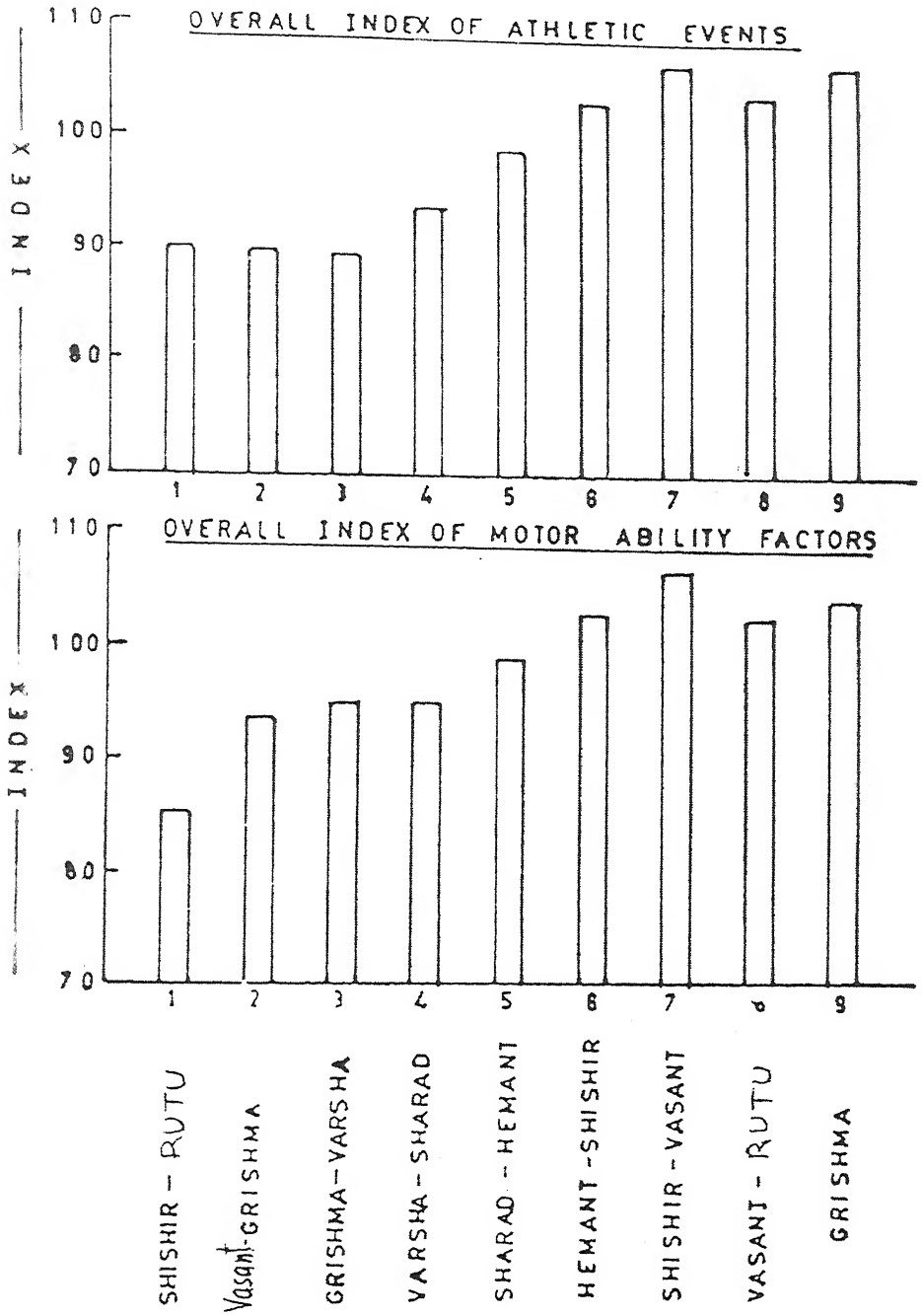
TABLE-45

Indioes of Motor Ability Factors for different Rutus

FACTORWISE

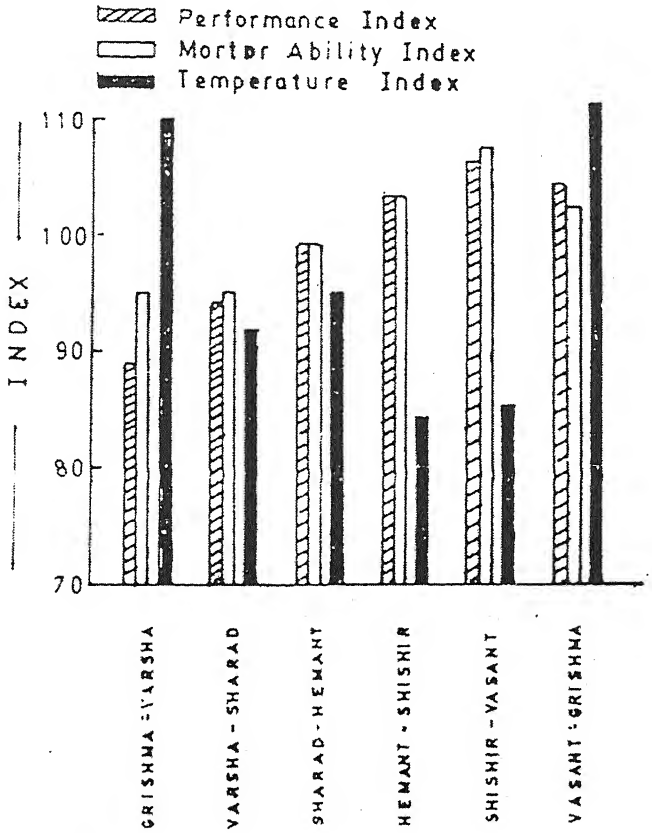
Rutu	Date	Index for the Factor			Overall Index
		Medicine Ball Put	Zig-Zag Run	Standing Br. Jump	
Shishir-Rutu	15.02.82	78.10	83.30	94.20	85.20
Vasant-Grishma	07.05.82	92.50	92.20	95.60	93.43
Grishma-Varsha	20.06.82	95.10	92.70	97.00	94.93
Varsha-Sharad	20.08.82	94.73	96.88	92.88	94.83
Sharad-Hemant	20.10.82	97.94	100.28	97.55	98.59
Hemant-Shishir	20.12.82	102.29	103.91	102.21	102.80
Shishir-Vasant	20.02.83	106.51	105.45	107.77	106.58
Vasant-Rutu	20.04.83	103.88	100.94	102.31	102.38
Grishma-Rutu	20.05.83	107.90	104.40	99.90	104.07

Overall Indices of Athletic Events and Motor Ability Factors for Different Rutus



Seasonal Indices of (i) Athletic Performance (ii) Motor Ability Factors and (iii) air temperature for different Rutus

Rutu	Performance In Athletic Events	Index For Motor Ability Factors	Air Temperature
Grishma-Varsha	89	95	110
Versha-Sharad	94	95	92
Sharad-Hemant	99	99	95
Hemant-Shishir	103	103	84
Shishir-Vasant	106	107	85
Vasant-Rutu	104	102	111



The analysis of variance have been worked out for all the four athletic events and three motor ability factors for each group of students under test. Tables-31 to 39 show the analysis of variance for each character.

1. Variations between students : The students selected for tests belonged to a homogenous group, as has been assessed by McCloy's classification Index which is based on their age, weight and height. However, it is likely that the performance may vary from student to student due to several other unknown factors, which are not accounted or could not be quantitatively measured here. This is an inherent characteristic as the athletes improve their performance from time to time or exert to yield better performance in competition with other fellow athletes. The analysis of variance test showed a significant variation in selected athletic events and motor ability factors from student to student.

The main object of the present study, however, lies in examining the variations of the scores between Rutus, that is, seasonal variation. It is from this point of view that the variations from Rutu to Rutu are studied in details.

2. Variations between Rutus : The F-statistics between Rutus obtained from these tests are given in the Table-40.

TABLE-46

Test of Variance Ratio (F) for "Between Rutus" Athletic Events.

Group	Observed (F)				5 %
	100 M Run	Shot Put	High Jump	Long Jump	
A	117.79	19.16	42.07	26.91	2.00
B	44.78	71.75	33.36	16.23	2.50
C_1	18.54	29.34	20.63	9.67	2.52
C_2	70.34	84.83	17.12	9.35	2.47
C_3	30.16	20.55	15.98	63.85	2.52

TABLE-47

Test of Variance Ratio (F) for "Between Rutus" Motor Ability Factors

Group	Observed (F)			5 %
	Medicine Ball Throw	Zig Zag Run	Standing Broad Jump	
A	117.79	19.16	42.07	26.91
B	11.92	119.41	32.99	2.50
C_1	22.18	77.89	36.63	2.52
C_2	7.27	81.03	38.70	2.47
C_3	5.06	17.54	21.74	2.52

(a) Athletic Events : The observed F-values for Group-A vary from 19.16 to 117.79 with the highest value belonging to 100 meters running. The other remaining groups also show fluctuations in F-value from 9.35 to 84.83. These observed F-Values are highly significant as

compared to the 5% F-value (2 to 2.52). The only exception is group C_3, where for shot put F-value of 2.55 is observed which is also 'Significant' at 5% level.

(b) Motor Ability Factors : The observed F-values from the test of analysis of variance for group A ranged from 10.03 to 102.49. For the other groups the F-value fluctuated from 5.06 to 118.41. These observed values are highly significant as compared to 5% values (2.02 to 2.52).

The test of analysis of variance thus yields highly significant values for F-statistics between Rutus. This proves that the scores in the various athletic events and motor ability factors are not stationary and go on changing significantly between various rutus. Thus the rutus have a significant impact on the performance level in athletics.

SEASONAL INDICES OF ATHLETIC PERFORMANCE

The collection of data on the scores of performance according to the different time periods belonging to different Rutus formed a Time Series Sequence. The time series normally have the following features :

1. Trend
2. Seasonal Variations
3. Cyclical Fluctuations
4. Random Fluctuations.

The present data belongs to 15 months which means only 9 Rutus. This is a very small number to study the series for cyclical fluctuations. Hence only trend and seasonal variations are discussed below:

1. Trend : The various graphical presentations in figure disclose the general tendency of variations of the scores in different athletic events and motor ability factors with respect to time. No statistical long term equation could be fitted to these, the data being very meagre of the order of 5 to 9 observations only in time, for each of the character studied. But the broad tendencies of variations in the athletic scores has been discussed only with those of air temperatures earlier in article 3.5.

2. Seasonal Variations : The information on the scores is collected for group A for 9 tests in the course of 15 months belonging to different Rutus. For other remaining groups five tests during 8 months period were conducted. The tests were based on four selected athletic events and three motor ability factors which were available for each group of students. Enough data on the seasonal scores were, therefore, available for 5 to 9 seasons on different samples. It was, therefore, considered useful to obtain the seasonal indices from these scores which would be helpful in assessing the impact of the Rutus on athletic performance.

The average scores tabulated in Table on the various groups and events came to aid in preparing the seasonal indices for the respective characters. Table-41 to 43 give the indices of performance for each of the four athletic events and three motor ability factors according to different Rutus separately for each group. The overall index for each group is prepared by averaging the indices for all the events in each Rutu. Table-42 shows groupwise indices of performance for athletic events for different Rutus. The Table-43 likewise gives the "Eventwise" indices of performance, by pooling all the groups pertaining to each event, which are shown graphically in figure.

Similarly, the groupwise indices of motor ability factors in different Rutus are shown in Table-44 while Table-45 shows the factorwise indices shown also graphically in figure.

The seasonal indices of performance in athletic events and motor ability factors given in Tables 40 to 42 are superimposed for various athletic events and motor ability factors belonging to the same group, which are shown in figure. The indices follow the similar pattern in all the athletic events and motor ability factors. These are well intermixed for each group. This gave the basis for preparing the groupwise and eventwise indices for athletic events (Tables 42 and 43), and groupwise and factorwise indices for motor ability factors Table 44 and 45.

Fig shows the overall indices for athletic events as well as motor ability factors for the 9 Rutus. The salient features are discussed below:

(a) Overall Index for Athletic Events: The overall observed indices for the athletic events stood at 90-28 in the initial performance test, i.e. Shishir-Vasant Rutu. The index declined slightly in the Grishma Rutu and in the Grishma-Varsha Rutu. The index rose to 93-69 in Versha-Shared Rutu and thereafter increased in every Rutu by about 3.5 units, reaching the highest value of 106.49 in Shishir-Vasant Rutu. Then again it declined to 103.61 in Vasant-Grishma Rutu. The index of group A for Grishma Rutu at the end of experimental period appears to be higher as it has been the only observation available in the study.

(b) Overall Index for Motor Ability Factors: In the initial performance test the overall index for motor ability factors was observed to be 85.20. The index shot by about 8 points in Grishma Rutu, but

remained stable at 95 till Varsha-Sharad Rutu. The index was 98.59 in Sharad-Hemant Rutu which was rising by about 4 units in the succeeding Rutus and was the highest (106.58) in Shishir-Vasant Rutu. Thereafter in Vasant-Rutu and in Grishma Rutu the index declined to 102.38 and 104.07 respectively.

Out of the nine seasonal indices observed for both the athletic events as well as the motor ability factors during experimental period the six seasonal indices recommended for the six Rutus of the year are shown in figure. The seasonal indices for the air temperature observed at Amravati, during experimental period were also prepared for 9 Rutus and plotted side by side with the other indices in figure.

DISCUSSION

The performance in the athletic events of various students belongings to different groups under the experimental study were consolidated and complied to disclose the broad features of variations in different events.

The minimum to maximum fluctuations in different groups in various Rutus for the four athletic events studied, are given by the "range". The standard Deviation also worked out for various Rutus represent the extent of variation in the score from student to student. The range and standard deviation statistics are found to be fealty stable in different Rutus. The small variations noticeable are negligible. It is, therefore, concluded that the accuracy of the experimental observations and homogeneity of data are well maintained in different Rutus throughout the experimental period.

The initial performance test was conducted in February i.e. Shishir Rutu for group A students which was under the experiment for 15 months' Rutus, covering in all the four athletic events for nine tests. The initial performance was seen to be reduced slightly in the second test conducted in May. This was attributed to Vasant Grishma Rutu. The performance in the third and subsequent tests went on gradually improving and at times increased subsequently as the experiment continued through Varsha-Sharad and Hemant Rutus. The performance reached the highest level in the next Shishir-Vasant Rutu i.e. February. Thereafter, the performance started declining again in the Vasant Rutu and in Grishma Rutus.

The other experimental groups viz. B, C_1, C_2 , C_3 were started in August i.e. Varsha-Sharad Rutu. Only five tests could be conducted on these groups. Ample scope was provided to conduct the experiment on the three groups in the changing Rutus conditions like Versha, Sharad and Hemant. It was observed that the trend of performance with the Rutus among these groups was similar to that of group A. The performance went on improving and was maximum in Shishir-Vasant Rutu in all the four groups, which subsequently showed downward trend with the onset of Grishma.

In addition to four athletic events in all the five groups, the three motor ability factors viz. Medicine ball put, zig zag run and standing broad jump were observed simultaneously with the four athletic events during the entire experimental period. The fluctuations which were already observed and recorded in athletic events were also seen present in the three motor ability factors.

The variations as seen above for in the athletic events and motor ability factors are found to be the performances resembling the cyclic type variations in the weather data, demonstrated in Fig. More closely. The air temperature data shown in Table follows a similar pattern of variation. These variations in air temperature are, however, in the opposite direction to those of the athletic data.

The average air temperature was 24.39°c in the initial. Performance test conducted in Shishir-Vasant Rutu. In Grishma Rutu the average temperature reached the highest value of 34.65°c. It is at this time when the second test was conducted on Group A, the level of performance was found declined in Grishma Rutu when the temperature were the highest. The air temperature dropped to ..... With the onset of Varsha Rutu and was decreased by about 5-6°c in Varsha and Hemant Rutu.

The relative humidity of Varsha Rutu was at its peak i.e 83-86%. The performance in athletic events and in motor ability factors was affected by the extreme humidity, even though the reduction in air temperature might have helped in developing the performance still better, but the increase in performance was not significant, as the rate of increase was retarded by the extreme humid climate.

In Hemant-Shishir Rutu the air temperature was at its lower ebb i.e. 23.38°c which was well maintained in Shishir-Vasant Rutu also. Simultaneously, the rate of decrease in relative humidity was rapid and it reached 61% which means the reduction of abrupt 25%. The improvement in the performance was seen to be steeper due to this type of climatic change in the Hemant-Shishir Rutu. This sharp climatic change

was observed much healthier than the proceeding Rutus to advance the performance to its highest level in Shishir-Vasant Rutu.

The air temperature started rising with the onset of the new Grishma Rutu, when the temperature was 32.34°c which further rose to 34.65°c in the same.Rutu till the end of the last experimental test.

It was observed during this period that scores in the athletic events and in motor ability factors started declining.

Thus, the trend of variations in air temperature in different Rutus goes hand in hand with that of the performance in athletic events or motor ability factors, but in the opposite direction. The Rutus in this manner appear to influence the performance in athletic events.

(a) Analysis of Variance Test: The seasonal pattern of variation in the scores is examined by the statistical test of Analysis of Variance wherein the student to student variation is eliminated and variations purely due to Rutus are tested for significance. The obtained values of 'F' are found to be highly significant n all the cases except one which is only 'Significant', leaving mo doubt to assume that the scores in different tests alter significantly from Rutu to Rutu.

(b) Time Series Analysis and Indices of Performance: The trend in the scores with the changing time could not be worked out as the sample size available was very meager, the maximum number of observations with respect to time being only 9 in the respective events. However, efforts have been made to evolve seasonal indices for various Rutus, by making use of the data on the scores in different events and pooling the seasonal indices of several samples groupwise, eventwise and factorwise (for Motor Factors) etc.

It has been observed that the pattern of seasonal indices worked out from several such samples, has remained fairly stable, both for athletic performance in different athletic events and motor ability factors and also from group to group of students. This could help in evolving seasonal indices for 6 Rutus during a year.

FINDING OF THE EXPERIMENTAL STUDY

In view of the statistical treatment given to the data and in the light of discussion that was held earlier, following finding of the Experimental study can be ascertained:

1. Performance in athletic events and motor ability factors deteriorates in Grishma Rutu.

2. The improvement in performance in Grishma-Varsha Rutu is insignificant.

3. The rate of increase in performance is higher in Sharad-Hemant and Hemant-Shishir Rutus, as compared to earlier Rutus.

4. The performance is observed to be highest in Shishir-Vasant Rutu.

5. In the Vasant-Rutu and Grishma Rutu of the subsequently year, the performance is higher as compared to the same season of the previous year. This may due to the improvement in the ability of the student with time. It may further be noted that:

6. The athletic performance level decreases when there is more air temperature and less humidity.

7. The level also goes down when the air temperature is less but humidity is more.

8. The performance level goes up when there is less temperature and less humidity.

INFERENCES

To the beginning of the experiment, certain presumptions were made regarding the performance and the season, further, that the hypotheses were also formed. In the light of findings of experiment the status and standing of the hypotheses may be examined.

(1) It was presumed that the athletic performance did not get affected by the variation in seasons. The findings suggest that the athletic performance level lowers down in Grishma Rutu and improves in Sharad-Hemant and Hemant-Shishir Rutus. The air temperature and humidity also influence the performance level. Therefore, the presumption that the athletic performance does not get affected by variation in season, stand rejected.

(2) It was further presumed that the athletic performance that was recorded in one season remained unaffected in other seasons where training influence was eliminated.

In the present experiment athletic performances were recorded in different seasons without imparting any scientific training to the subjects. A critical and analytical study of all these performances of different seasons reveals that the performance level gets affected and show great fluctuation with variation in season even when training influence is eliminated. Thus, the second presumption also stands rejected.

The three hypotheses that were formulated earlier also stand rejected.

It may therefore, be established that:

(a) There is significant difference in athletic performance level of the high school students in summer and winter seasons.

(b) Performance level of the high school students in athletics does not remain constant throughout the year.

(c) Performance in athletics is not independent of air temperature and humidity.

Within the limits of the present study it can be concluded that Rutus (seasons) do have a significant influence on the performance of various athletic events and motor ability factors.

CHAPTER - 5

SUMMARY CONCLUSIONS AND RECOMMENDATIONS

CHAPTER V
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Ayurved is the science of health and medicine developed in India centuries past. Ayurvedic system of medicine is still prevalent and popular in India. It deals not only with the treatment and diseases, but also with the measures for promotion of health. Importance of exercise, diet and hygiene in the preservation of health has been duly emphasized by this system. Principles pertaining to the practice of exercise are laid down in the Ayurvedic Texts of Ancient India.

According to Ayurvedic concept the year is divided into two principal seasons : vis (i) Adankal or Hotter season and (ii) Visargakal or cooler season, each of six months' duration. They are further divided into three smaller seasons termed as "Rutu". There are three rutus viz. Shishir, Vasant and Grishma of Adankal and Varsha, shared and Hemant of Visargakal.

It is further stated in Ayurved that the natural strength of the body shows fluctuation according to the seasons. It is dissipated and remains at its lowest ebb during the summer season; and it achieves its highest optimum level during the winter months. Ayurved has contraindicated practice of physical exercise during Vasant, Grishma and Varsha i.e. summer and rainy months; whereas physical exercises are indicated during winter months, i.e. shared, Hemant and Shishir and Rutus.

This knowledge of Ayurved seemed to have great bearing on

the athletes of India and other tropical countries who undergo heavy bond of physical training in the pursuit of recording high performance in Olympic games usually organized during July and August months. These 'Games', since their beginning in 1896 at Athens, except for once, have been organized at the places above 35° Latitude, where heat is no problem at all. Mexico city Olympics in 1968 were below 30° Latitude ranging in tropics, but because the city is located at 7000 feet above sea level, heat problem was not felt by the athletes. Indian athletes' performance during Olympic meets of the past were found never encouraging, with a few exceptions.

In order to enable the Indian athletes to be ready for Olympic competitions, they have to be at the climax of their training load during the summer months, viz. March, April, May and June. These months are very critical and burden some for the athletes as the weather conditions are not favourable. Summer heat in India exceeds 100°F at most of the leading cities. At some places mercury crosses the mark of 110F. Athletes have to bear with this environmental heat.

Acclimatization is considered useful process for the preventation of heat disorders. Acclimatized athlete can withstand heat stress and also perform in a better way than unacclimatized athlete.

High humidity with high temperature creates problem of body-heat dissipation. The normal comfortable relative humidity is generally considered 30 to 70%.

Discomfort index, derived from the mean of dry and wet bulb temperature, suggests a scale of heat load. It is suggested that strenuous physical activities are to be suspended at the place where discomfort index exceeds 28 units.

Biorhythm is the study of cyclical biological changes and their relationship to activity. Outstanding physical performance are more likely to occur during the positive phase of the biorhythm cycles. Every biological process has a specific optimal temperature, which differs for the different organisms. Body temperature rhythm of an athlete is particularly important because performance ability closely follows the peaks and lows of the body temperature rhythm. Athlete should consider the impact of circadian rhythm on training and competition in different geographical regions and at different times of the day.

Thus, considering the probable impact of season and weather condition on the ability of a person, a hypothesis was formulated staging that the variation in seasons influences the performance level of the athletes. To be more specific, following purposes of study were aimed at :

1. To find out effect of season on the increased reduce the body fat.

2. To find out effect of seasonal variation on the performance level.

FAT CHANGES

1. There were no significant differences between the summer and winter training in running on body fat and endurance after two weeks of training programme.

2. Training in running in summer can reduce the body fat, but for this minimum period of training schedule should be at least four weeks and for better result more than four weeks of training is required.

3. Endurance can be developed through the training in running in both summer and winter season, but training in winter shows the greater improvement provided that at least four to six weeks of duration is required.

EXPERIMENTAL STUDY

The experimental study was conducted on high school students. About 150 students of 9th to 11th class were selected randomly from the five different schools, ranging between 15 to 20 years. They were classified on the basis of McCloy's classification Index-II into five groups. The first group viz. Group 'A' consisting of 17 students was meant for longterm experimentation of 15 months; whereas remaining 4 groups viz. B, C_1, C_2 and C_3 were for 9 months observations. Four athletic events consisting of 100 Mts. Shot put, Long Jump, and High Jump and three factors of motor ability viz. Zig-zag run, medicine ball put, and standing broad jump were the items in which performance of the all the five groups was recorded with standard procedure towards the end of each "Rutu" (season) as described in Ayurveda and in the Indian antra inimical calender. Thus, group 'A' was tested in all the 7 events for 9 times during the period of 15 months. Remaining groups recorded their performances in the same 7 items for five times in a period of nine months. Thus, with the total 3941 performances of 99 students logical conclusions were derived after applying various statistical tests.

CONCLUSIONS

Study of the two parts has revealed some common findings. These findings are discussed thoroughly in relation to the purposes of study under chapter-4. The discussion further gave on insight for deriving

some important inferences. Ultimately, with the available data of the two parts, their findings, and comparison with each other and the inferences at hand, following logical conclusions can be justifiable :

1. It is concluded that seasons influence performance level of the athletes. A change in season also causes cognizable fluctuation in the performance level of the athletes.

2. Summer or hotter season i.e. from March to August in India is not favourable to Indian athletes both, for continuing vigorous training, so also for recording higher and better performances.

3. Winter i.e. from September to February in India is comparatively much helpful to the athletes in executing heavy training schedule as well as in recording better performances.

4. High percentage of relative humidity with high temperature is detrimental to the health of the athletes. Performance deteriorates in such a weather.

5. The knowledge pertaining to exercise, bodily-strength and season contained in Ayurvedic Text stands true and applicable even in present period. This has been duly supported by the findings of the present study, so also by the other research findings.

RECOMMENDATIONS :

The present study is viewed from two different angles : on the one hand, it deals with the investigation of the present day crisis of athletic training in India under adverse conditions of the season and climate. On the other band, it tries to find out if any, relationship of the

3. Scientific observations of the present training centres where national level athletes are trained, should be made in respect of the climatic conditions, and further investigations be made to find out impact of these conditions on the performance level of the athletes and other sportsman.

4. Athletes and athletic coaches should be properly educated about the hazards of hot climate and their effective preventation.

5. Training of the Indian athletes preparing for Olympic Games be held atleast during the three summer months, viz. April-May and June at the places of temperature climate where ambient temperature remains below 100°F during these months.

6. As the summer in India is very severe, it causes detrimental effect on the performance level of the athletes. Therefore, on the basis of the major finding of the present study it is proposed for the consideration of the concerned authorities to undertake survey on national level to find out suitable summer resorts in India, where after creating necessary infrastructure of sports facilities national level probable athletes selected for Olympic games should be stationed during the summer months for continuing their training without affecting its intensity and duration.

Creating infrastructure of sports facilities at the places declared as summer resorts for sports, should form part of "Sports Development Programme in India" at national level. Such resorts would not only give great relief to the coaches as well as athletes

from overtaking and burning themselves in scorching heat, but more than this, it will enable them to increase intensity and duration of their training with considerable case, and prepare for high performance without any discomfort.

7. In view of the finding of the study regarding verification of the knowledge of Ayurved about badly-strength, exercise and season, it is proposed that intensive study of Ayurved may be undertaken by the research workers from physical education and sport science point of view. It would certainly yield better results. In this respect, following proposals are worth considering :

   i. Studies of scientific principles of exercise in the light of modern methods be conducted to as certain their utility in present conditions.

   ii. Studies of the Indian athletes in respect of their physique and effect of diet and vyayam on their health and fitness.

CHAPTER - 6

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